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SEABIRD MONITORING
CHANNEL ISLANDS NATIONAL PARK
1991–1992

TRUDY INGRAM
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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ABSTRACT

Seabird monitoring was conducted at Channel Islands National Park in 1991 and 1992. Seven bird species were monitored on Santa Barbara, Anacapa, Santa Rosa, and San Miguel Islands. Population and reproductive estimates were made for pelicans, cormorants, gulls, and murrelets on Santa Barbara. Reproductive success was determined for gulls on East Anacapa and for pelicans on West Anacapa. Monitoring of Snowy Plover nests was initiated on Santa Rosa Island in 1992.

INTRODUCTION

The largest seabird colonies in Southern California occur in Channel Islands National Park (CHIS) and neighboring San Nicolas Island (see Figure 1). This report presents monitoring data col-lected during 1991 and 1992 for selected breeding seabirds in CHIS. Monitored species and colony locations are presented in Table 1.

We present data for two years, not only for practical reasons, but because it focuses attention on the marked differences that often characterize seabird breeding performance between years. This was especially evident for 1991 and 1992 since the normal oceanographic and weather patterns of 1991 changed to severe El Niño conditions in 1992. Disruptions of the food chain caused by such events can be manifested very quickly and dramatically at seabird colonies in the form of breeding failures.

The CHIS Seabird Monitoring Program began in 1985 and has been conducted each year since then (Lewis and Gress 1985; Lewis and Gress 1988; Ingram 1992). In 1991 and 1992, data collected included phenology, breeding effort, breeding success, and breeding population size for selected species and colonies. Details of monitoring protocols, species selection criteria, and variables measured can be found in the Seabird Monitoring Handbook (Ingram et al. 1983; Lewis et al. 1988).

MONITORING EFFORT

In addition to the park's efforts, data were collected through four other programs: 1) California Institute of Environmental Studies/University of California, Davis Brown Pelican monitoring (F. Gress), 2) U.S. Fish and Wildlife Service (USFWS) Seabird Colony Survey of Southern California, 3) Point Reyes Bird Observatory (PRBO) Snowy Plover Program, and 4) U.S. Navy (USN) San Nicolas Island Seabird Monitoring Program. These efforts were collaborative with CHIS, and a substantial portion of the data collection efforts were shared with the CHIS Seabird Monitoring Program.

Ongoing studies of California Brown Pelicans in the Southern California Bight (including breeding biology, distribution and movement patterns, and contaminants and human disturbance effects) provided phenology and breeding data for the West Anacapa Island colony in 1991 and 1992 (Gress 1992; Gress et al. 1993; Anderson et al. 1993; Gress et al., in prep.). Pelagic and Double-Crested Cormorant population data for Anacapa Island were also obtained as part of this study.

In 1991, a USFWS team from the Northern Prairie Wildlife Research Center (Dixon, California) censused all seabird colonies in Southern California to derive population size estimates (Carter et al. 1992). This work completed surveys of California coastal seabird colonies begun in 1989. USFWS survey techniques differed from those used by the park, and details of USFWS methods can be found in Carter et al. (1992).

Point Reyes Bird Observatory has conducted surveys of breeding Snowy Plovers on San Miguel and Santa Rosa Islands since 1989 and on San Nicolas Island from 1989 to 1991. These efforts are part of a long-term research project of plovers on the California mainland including breeding biology, movement patterns, and predation. Population size estimates of Snowy Plovers are also on-going in other western states and Baja California, Mexico. In 1992, studies were initiated to ascertain habitat use and breeding success for plovers on portions of Santa Rosa Island (Keimel 1992).

The San Nicolas Island Seabird Monitoring Program was initiated in 1992 by the U.S. Navy (Point Mugu Naval Air Weapons Station, Environmental Division) with assistance from USFWS (Northern Prairie Wildlife Research Center). As part of this program, aerial surveys were conducted of Brandt's and Double-Crested Cormorant colonies in CHIS to determine breeding population size.

The monitoring effort by CHIS and these programs is presented in Table 2. Total number of field days was 154 and 121 in 1991 and 1992 respectively. Total person-days (field days x number of workers) was 379.5 in 1991 and 226.5 in 1992. USFWS person-days in 1991 was 190, accounting for half of the total effort that year. This was due to relatively large numbers of workers spending shorter periods of time in the field compared to the CHIS and Gress efforts where fewer workers (usually one or two) spent time in the field over a period of months.

F. Gress's contributions on Anacapa Island (44 days in 1991 and 30 days in 1992) enabled CHIS, as in previous years, to complete other monitoring activities occurring simultaneously on other islands. Fewer days were spent in the pelican colony in 1992 because there were fewer nests as a result of the El Niño. The larger effort by CHIS in 1992 (87 days, 69 days in 1991) was due to increased program staffing. Contributions from the USN San Nicolas Island Seabird Monitoring Program began in 1992, but those data were not available for this report.

DATA MANAGEMENT

A first attempt at data management for the CHIS Seabird Monitoring Program was initiated in 1990. Details from this effort, including methods of data collection, archival, and analysis for monitored species, can be found in Ingram (1992). In general, an attempt was made to integrate formats for data collection, computer data entry, and subsequent data analysis using descriptive statistics. Trend detection was not attempted and remains beyond the scope of this report.

An important issue not addressed in Ingram (1992) is that methods of data handling may vary between years from the standard protocols outlined in the Seabird Monitoring Handbook (Lewis et al. 1988). This is often the result of missed scheduled visits to colonies during critical times in the breeding cycle. When this occurs, decisions are made regarding data collection and handling that, unless stated explicitly, make meaningful comparisons difficult.

Some data treatment is discussed under the individual species accounts in this report especially when it varies from methods in the handbook. However, this is not a complete account, and this issue requires greater attention in future reports (see section on Management Issues).

SUMMARY OF RESULTS

CALIFORNIA BROWN PELICAN

Breeding effort was very low in 1992 (1,486 pair, West Anacapa; 266 pair, Santa Barbara) compared to 1991 (5,765 pair, West Anacapa; 618 pair, Santa Barbara). Nesting success, however, was substantially reduced in both years. On Anacapa Island, young fledged (fledglings per nest attempt) was 0.28 in 1991 and 0.25 in 1992; on Santa Barbara Island, productivity was 0.31 in 1991 and 0.08 in 1992. In both years, nesting failures were characterized by rates of nest abandonment over 75% at both colonies. Since 1985, nesting effort has varied considerably on West Anacapa Island while productivity has decreased. On Santa Barbara Island, both nesting attempts and productivity have declined.

DOUBLE-CRESTED CORMORANT

At West Anacapa Island, the number of nests attempted were 360 and 262 in 1991 and 1992 respectively. Productivity was estimated at 1.63 and nest abandonment was 9.2% in 1991. Productivity was 1.16 and 25.2% of nests were abandoned in 1992. Nesting attempts per year have increased over the past decade, but productivity has decreased since 1985. At Santa Barbara Island, from ground counts, 262 and 193 pairs attempted nesting in 1991 and 1992 respectively. Two areas were only partially visible from island observation points. From aerial photos, which censused all areas completely, nesting pairs totalled 509 in 1991. Estimated productivity was 1.72 (from one sample area) and nest abandonment was 12.2% in 1991; for 1992, productivity was 1.04 and nest aban-donment was 39.5%. Since 1985, reproductive effort has increased and productivity has decreased. At Prince Island, there were 230 and 107 nest attempts in 1991 and 1992 respectively. Nesting success was not determined in 1991. In 1992, productivity was 1.15.

PELAGIC CORMORANT

There were 136 nest attempts on East, Middle, and West Anacapa Islands in 1991 and only 48 attempts in 1992. Productivity was 1.82 in 1991 and 1.55 in 1992.

WESTERN GULL

For gulls, nearly all reproductive parameters measured were higher in 1991 than in 1992 on Santa Barbara and East Anacapa Islands. Hatching success and fledging success for Santa Barbara Island gulls were very low in 1992 (0.59 and 0.50

respectively). Gulls on Anacapa experienced relatively high hatching success in 1992 (0.80), but fledging success was low (0.51), and chick growth rates were at the starvation level (16.19 g/day). Fish species predominated in chick diets in both years. Squid, a significant dietary component in 1991, was nearly absent from samples in 1992. Total nesting effort in 1991 on Santa Barbara Island (2,450 pair) was the highest recorded in the last 20 years. Productivity has declined since 1982.

XANTUS' MURRELET

Nesting effort was higher in 1991 (mean clutch size = 1.62) than in 1992 (mean clutch size = 1.36). Mean hatching success was about 50% in 1991 and 33% in 1992. Most egg mortality was due to predation by endemic mice. Estimated mean productivity (hatchlings per nest attempt) has varied between 0.4 and 1.4 over the last 10 years.

CASSIN'S AUKLET

Nesting attempts were slightly lower in 1992 (39) compared to 1991 (42) from a sample of 50 nest boxes on Prince Island. Fledging success was high in both years (0.93 in 1991; 1.00 in 1992). Initiation of nesting in 1992 did not begin until late April.

SNOWY PLOVER

Plovers continued to breed in very small numbers on San Miguel Island (19 in 1991; 23 in 1992). On Santa Rosa Island, breeding adults numbered 103 and 115 in 1991 and 1992 respectively. The Skunk Point area harbors more than half the breeding effort on this island. In 1992, hatching success in the Skunk Point area was very low (27%). Most eggs were lost to wind and ravens.

Two species, Tufted Puffins and Rhinoceros Auklets, were added to the Channel Islands list of breeding seabirds by USFWS biologists in 1991. They estimated 10 breeding puffins at Prince Island (absent there since 1912 as breeders). They also found 19 breeding auklets (first ever documented breeding in the Channel Islands) in the San Miguel Island area.

MONITORED SPECIES ACCOUNTS

CALIFORNIA BROWN PELICAN *(Pelecanus occidentalis californicus)*

In 1991 and 1992, Brown Pelicans were monitored on West Anacapa and Santa Barbara Islands. A detailed account of methods used for ground counts can be found in Gress (1992). Breeding success and status of Brown Pelicans in the Southern California Bight is given in Anderson and Gress (1983), Gress et al (1990, 1993). In 1991, CHIS and USFWS experimented with aerial photographs as a technique for censusing pelicans on West Anacapa Island.

Field time required to monitor pelicans varies with nesting effort and weather conditions. Access to West Anacapa Island is difficult and some observations must be made from a boat. In 1991, F. Gress (CIES) completed six trips to West Anacapa beginning in late March (first eggs) through late September (chick mortality and post-season nest count). The number of days per trip varied between five and nine for a total of 44 field days. In 1992, when nesting effort declined from 1991 levels, due likely to the effects of El Niño. Six census trips were made to West Anacapa in 1992 from late April through early September. Trips varied in length from two to seven days, and total number of field days was 30.

Censusing Double-Crested Cormorants on West Anacapa and Pelagic Cormorants on East, Middle, and West Anacapa was also completed during these field trips. However, approximately 90% of the field time was spent censusing Brown Pelicans.

On Santa Barbara Island, censusing Brown Pelicans is easier than on West Anacapa because most can be done from land-based observation points, fewer birds nest there, and topography does not substantially limit visibility as it does on Anacapa. In 1991, eight montly surveys were completed by CHIS between late February and late September. In 1992, 10 censuses were completed between late February and mid-August.

Definition of Terms

Nest attempt. A nest structure, either partially or completely constructed in the census year,

identified by the presence of eggs, incubating adult, chicks, or fresh nest bowl material.

Abandoned nest. A nest abandoned since previous census (when incubating adult was present), identified by the presence of fresh nest bowl material.

Fledgling. A chick that has attained flight ability (usually 13 weeks of age), identified by feather color and pattern.

Successful nest. A nest (pair) that raises at least one chick to fledging.

Productivity. Number of young fledged per nest attempt.

Phenology

The 1991 Brown Pelican breeding effort was lengthy, especially on West Anacapa Island where it spanned nine months (Figure 2). Egg laying began in February on both West Anacapa and Santa Barbara Islands. Severe storms throughout March retarded the breeding effort and was probably a major factor in the abandonment of a large number of nests already containing eggs.

Egg laying in 1991 extended well into July on West Anacapa and through May on Santa Barbara Island. Hatching, and fledging extended from late March through early November on Anacapa and through late September on Santa Barbara Island.

In 1992, breeding seasons on both islands were relatively short (Figure 2). Egg laying through fledging lasted six months on Anacapa (late February through early September). On Santa Barbara Island egg laying began in early March and ended in early August. Both efforts were accompanied by large-scale nest abandonment during the egg and small chick phases.

Nesting Success

Breeding occurred at traditional nesting locations on West Anacapa in 1991, and the total number of nest attempts was relatively high at 5,765 (Figure 3). In contrast, in 1992, breeding did not occur west of Box Canyon (Site 6; Figure 4) and the total number of nests attempts was only 1,486.

On Santa Barbara Island pelicans also nested in traditional locations (Figure 5). Reproductive effort was moderate in 1991 with 618 nest attempts and low in 1992 with 266 nests.

High rates of nest abandonment were observed at both colonies in both years. On Anacapa, 79% (4,547 nests) and 78% of nests (1,153 nests) were abandoned in 1991 and 1992 respectively (Tables 3, 4). As a result, productivity was low and likely effected by El Niño. Productivity was 0.28 (1,602 young fledged) and 0.25 (372 young fledged) in 1991 and 1992 respectively.

On Santa Barbara Island, nest abandonment was 75% (461 of 618 nests) in 1991 and 89% (237 of 266 nests) in 1992 (Tables 5, 6). Productivity was 0.31 in 1991 (187 young fledged) and 0.08 in 1992 (22 young fledged).

Since 1985, the reproductive performance of Brown Pelicans in the Channel Islands has decreased (Figures 6, 7). Despite the large nesting efforts on West Anacapa in recent years, productivity has remained low with a 5-year mean of 0.46 for the period 1988–1992 (Figure 6; Appendix A). On Santa Barbara Island nesting effort has declined along with productivity: the 5-year mean productivity is 0.25 for 1988–1992 (Figure 7; Appendix A).

Pelican Mortality On The Mainland

In addition to poor nesting success at breeding colonies, we also observed a die-off of Brown Pelicans along Southern California beaches in 1992. Wildlife rehabilitation centers from Santa Barbara to San Diego Counties reported much higher than normal numbers of starving and injured pelicans during the summer months, although we have no estimate of total numbers involved. One rehabilitation center in Santa Barbara picked up 150 dead Brown Pelicans on beaches in that city on a single day (June 22). We examined over 25 carcasses found in the harbor at Ventura, California. Most of these were well below normal weights and appeared to have starved. Some dead birds were delivered to Dr. D. W. Anderson (University of California, Davis) for detailed examination.

New Census Techniques

Aerial Photography. Because the nesting effort of Brown Pelicans has increased to over 5,000 nests in recent years, the need for a less labor intensive yet cost effective method for censusing pelicans is desirable. To this end, in 1991 we began experimenting with the use of

aerial photographs for censusing nests and large young on West Anacapa Island.

We tried two different methods. The first format has been used successfully for censusing Double-Crested Cormorants, Brandt's Cormorants, and Common Murres throughout California by USFWS (see Takekawa et al. 1990; Carter et al. 1992). It involved using a standard 35-mm camera equipped with 300 mm lens and motor drive. Photos were taken from a twin-engine Partanavia at altitudes ranging from 400–700 feetground. The other method, developed by Southwest Fisheries Science Center, NMFS, uses a large-format, high-resolution camera (used in the past for military reconnaissance missions and recently developed for censuses of marine mammals). This camera was belly-mounted in a similar aircraft and photos were taken at 700–1,000 feet above ground level.

Preliminary results of these data indicated that photos taken with the standard format were not adequate for counting pelican nests or chicks in 1991. There were three main problems with this technique:

- Pelican nests and birds were distributed widely and in variable densities over a very large area of West Anacapa Island
- Nests and birds did not stand out well against the vegetated background.
- Plane motion and improper focusing in some cases resulted in poor quality close-up photos. In addition, a large amount of time was required to piece slides together to obtain non-overlapping counting units.

The high resolution format showed greater promise as an adjunct to standard ground counts (see Gress 1992 for ground count methods). Although all photos have not yet been counted, results at several Anacapa subcolonies show comparable or higher numbers of nests visible from photos than from island observation points. Whether or not abandoned nests are distinguishable in photos from nests used in previous years is not yet known. Since nest abandonment is often very high for pelicans, the ability to discern abandoned nests is critical. A drawback of this method is the exclusive nature of the equipment and film processing costs. This technology is not readily available to users that could benefit from it.

Airborne Video. Lee Graham at the University of Arizona, Tucson, has developed techniques that link a global positioning system (GPS) and Geographic Information Systems (GIS) with pictures taken from a plane using a video camera. Video tapes are subsequently interpreted in the lab.

The resolution and overall clarity of sample pictures using this method was better than from the high resolution photographs used in 1991 (at least for distinguishing between vegetation types). A computer monitor can be set up in the plane so that picture quality can instantaneously be monitored and modified if necessary. In addition, data for nests and chicks would be geographically-referenced automatically, a feature lacking in all data collection for the CHIS Seabird Monitoring Program so far. These techniques would be widely applicable and more available to many users and deserve further attention.

DOUBLE-CRESTED CORMORANT *(Phalacrocorax auritus)*

Double-Crested Cormorants were monitored on West Anacapa, Santa Barbara, and Prince Islands in 1991 and 1992.

West Anacapa Island. Censuses on West Anacapa Island were completed by F. Gress in both years as part of the Brown Pelican surveys there (see Brown Pelican species account).

Santa Barbara Island. On Santa Barbara Island, CHIS completed eight surveys both years, beginning in April and continuing through August. Chick counts were taken from one clearly visible sample area (Site 1; Figure 11) approximately once weekly until chicks could no longer be associated with a particular nest.

Prince Island. Visits to Prince Island by boat were irregular due to bad weather and transportation scheduling problems. Three visits were made in 1991 (one by CHIS in early April, two by USFWS on July 10 and July 14). Four visits were made in 1992 by CHIS (May through August). We were not able to obtain data for nesting success in 1991 due to a two-month gap between visits. Productivity was derived from one sample area that could be censused from the island by CHIS (Site 2; Figure 13).

USFWS also conducted aerial surveys of cormorants on Santa Barbara and Prince Islands (one in mid-May and one in mid-June) in 1991 and 1992. We were able to compare ground counts with aerial photo counts for some areas on Santa

Barbara Island in 1991. The status of Double-Crested Cormorant breeding in the Channel Islands is given in Carter et al. (1992).

Definition of Terms

Nest attempt. A nest structure from the current year, with or without eggs, with incubating or brooding adult, or with chicks present.

Sample productivity. Number of large chicks in sample/nests with chicks in sample.

Colonywide productivity. Sample productivity x sample nests with incubating or brooding adults + chicks fledged in sample / nests in sample.

Fledglings, colonywide. Total nest attempts x colonywide productivity.

Phenology

Double-Crested Cormorants began nesting earlier on West Anacapa Island than on Santa Barbara Island in both 1991 and 1992 (Figure 8). On West Anacapa, nesting extended from mid-March (egg laying) through mid to late September (fledging) in 1991. On Santa Barbara Island in 1991, breeding occurred between late April (egg laying) and continued through early September.

In 1992, breeding began later and the season was considerably shorter on West Anacapa than it was in 1991 (Figure 8). Laying began in mid-April and extended only through mid-May. Fledging was completed by early September. On Santa Barbara Island in this year, timing was similar to that for 1991.

On Prince Island phenology was not determined in 1991, although the peak number of birds recorded as sitting on nests (incubating or brooding small chicks) occurred in mid-June. In 1992, nesting began in mid-April. By mid-July mostly large chicks were present at nests, although fledging had probably not started. We were unable to visit this colony in August and all chicks had fledged by early September.

Nesting Success

West Anacapa Island. Nesting occurred at traditional sites in both years extending from the Sea Lion Cove area (Site 1; Figure 9) on the west end to the Amphitheater (Sites 11–13; Figure 9) on the east end. There were 360 and 262 nests attempted in 1991 and 1992 respectively. Although overall attempts were higher in 1991, subcolony size tended to be larger in 1992 indicated by the mean sample sizes for occupied nests (by chicks or incubating adults) or abandoned nests (Tables 7, 8).

From 11 clearly visible subcolonies in 1991, nest abandonment was estimated at 9.2% and productivity was estimated at 1.63 ± 0.35, colony-wide (Table 7). In 1992, three subcolonies were used as sample areas. Nest abandonment was high (25.2%) and productivity was low (1.14 ± 0.15) compared to 1991 values (Table 8). We estimated 587 and 300 chicks fledged in 1991 and 1992 respectively.

While reproductive effort has continued to increase over the past 20 years, productivity has showed more variability (Figure 10). Productivity for the last four years (1989–1992) varied between slightly over 1.1 to 1.6 young fledged per nest attempt compared to the previous four years (1985–1988) when productivity varied between 1.6 and 2.5.

Santa Barbara Island. Cormorants nested primarily in the North Peak area (Site 1), West Cliffs (Site 2), and Sutil Island (Site 3) in 1991 and 1992 (Figure 11). Nest counts were made by CHIS from island observation points as well as by USFWS using counts from aerial photographs (see Carter et al. 1992 for methods). Differences in counts occurred in areas only partly observable from land. These were Site 2, where only about half the nests could be seen (ground: 102 nests, aerial: 233 nests) and Site 3 (ground: 60 nests, aerial: 172 nests).

From aerial photo data, we estimated 509 nests were attempted in 1991, including an additional 13 nests observed at Site 1 from ground counts (Table 9). Nest abandonment was 12.2% for a sample of 41 nests. We estimated colonywide productivity to be 1.72, and 875 chicks were estimated fledged.

From ground counts in 1992, CHIS counted 193 attempted nests (Table 10). Nest abandonment was high (39.5%), and productivity and number of birds fledged (201) were low (1.04 ± 0.28). These figures do not include USFWS aerial survey data that were not available for this report. Therefore, these figures underestimate nesting effort. This information is currently available in ???????.

Reproductive effort since 1976 has increased on Santa Barbara Island as indicated by ground counts made from traditional island observation points (Figure 12). However, it appears from results of the recent aerial surveys that nest counts prior to 1991 have underestimated the true total effort on this island and Sutil Island. However, given that the population has been increasing amidst a back-ground of variable ocean productivity between years, it is premature to attempt to calculate a cor-rection factor in order to determine real nest counts for previous years.

Despite the increasing nesting population, productivity has generally decreased at this colony during the period 1985–1992. Estimated productivity has changed from a high of 2.0 in 1985 to about 1.0 in 1992 (Figure 12; Appendix B).

Prince Island. Nesting areas were located on the upper cliffs on the east half of the island and varied between years (Figure 13). Total nest attempts in 1991 was estimated at 230 from aerial photos (Carter et al. 1992), and in 1992, we estimated 107 nest attempts from ground counts (CHIS) (Table 11; Figure 13). Since the 1992 counts do not include aerial survey data (USFWS, unpubl. data), nesting effort is underestimated.

Productivity was not determined in 1991 as mentioned above. In 1992, nest abandonment was high (31%) and productivity was low (1.15 ± 0.50 colonywide). Estimated number of chicks fledged was 123. These figures have not yet been adjusted for aerial count data.

Survey Techniques

Some of the problems in censusing Double-Crested Cormorants were described by Ingram (1992). The most difficult area to census is Prince Island, where accurate counts cannot be obtained by boat and where nesting may be confused with Brandt's Cormorants. Figure 14 exemplifies areas of nesting overlap for three cormorant species nesting on Prince Island in 1991 (USFWS, unpubl. data; Carter et al. 1992). Censusing at Anacapa Island is also difficult. All surveys arre by boat; sea conditions, viewing distance, and vegetaion are all limiting factors in obtaining good data.

Counts made from aerial photos (standard format, 35-mm camera) in 1991 and 1992 were more complete than counts made from a boat, since many of the areas cannot be seen from a boat. However, differentiating between Double-Crested and Brandt's was still difficult and could not be done accurately in some instances. Refer to Carter et al. (1992) for details on aerial survey techniques.

PELAGIC CORMORANT *(Phalacrocorax pelagicus)*

In 1991, USFWS (Carter et al. 1992) and Gress (unpubl. data) censused Pelagic Cormorants on the three-island Anacapa chain—East, Middle and West Anacapa. USFWS conducted a one day breeding-bird survey of the Anacapa chain on May 20, 1991.

Gress conducted additional surveys throughout the season and also examined breeding success. Surveys by Gress were conducted at the same times as those for Brown Pelicans and Double-Crested Cormorants and follow the same visitation schedule.

For purposes of this report, data from Gress and Carter were combined such that the highest count for a given subcolony is reported. This differs from data treatment by Carter et al. (1992) and readers are referred to that report for those details.

Gress (unpubl. data) also conducted surveys for Pelagic Cormorant breeding effort and breeding success on East, Middle, and West Anacapa Islands in 1992.

Definition of Terms

Nest attempt. A nest structure with or without attending adult or which contains chicks.

Sample productivity. Colonywide productivity, fledglings. See ***Definition of Terms*** for Double-Crested Cormorant.

Phenology

Timing of breeding for Pelagic Cormorants on Anacapa Island was similar in 1991 and 1992 (Figure 15). Egg-laying began in late February/ early March in 1991, and chicks fledged by the end of August. In 1992, nesting began in early March and was complete by mid-August.

Nesting Success

Almost all nesting occurred in and around the sea caves on the north side of West, Middle, and

East Anacapa in both 1991 and 1992. In 1991, a small number of nests (16) were built on the south side of these islands as well (Sites 10, 11, 17, 18; Figure 16). Since consistent nesting on Anacapa began in 1984, this was the only year in which a significant number of nests were located on the south side of the island (F. Gress, pers. obs.). There was a total of 152 nest attempts on the three islands in 1991 and 48 attempts in 1992 (Tables 12, 13; Figures 16, 17). As is typical for this species in the Channel Islands, nest groupings were small in both years but with larger mean number of occupied nests observed in 1991 (Tables 12, 13).

Colonywide productivity for 1991 was estimated at 1.98 ± 0.41 (301 chicks fledged) (Table 12). In 1992, productivity was lower (1.58) and only an estimated 74 chicks fledged from the three islands (Table 13). Sample sizes were too small to obtain productivity estimates separately for each island.

Except for 1992, Pelagic Cormorants have increased reproductive effort on Anacapa Island over the last eight years (Figure 18). Productivity has remained between 1.5 and 2.0 since 1986 (F. Gress, unpubl. data).

WESTERN GULL *(Larus occidentalis)*

We monitored Western Gull breeding phenology, nesting success, chick growth, and chick diet in three, 1-hectare (10,000 m^2) grids on Santa Barbara Island (Figure 19) and in two, 0.25 hectare (2,500 m^2) grids on East Anacapa Island (Figure 20) in 1991 and 1992. In 1991, six visits were made to the grids on Santa Barbara Island and eight visits to East Anacapa Island. Monitoring on Santa Barbara Island began in early May and continued through mid-July with visits spaced one to two weeks apart. On East Anacapa Island, monitoring took place between early May and early July, with visits spaced four to 12 days apart.

On Santa Barbara Island, all breeding pairs were counted in 1991 both by CHIS and USFWS. In 1992, only CHIS counted total breeding pairs there.

Definition of Terms

Nest attempt. A nest bowl that receives eggs (CHIS); a nest bowl with or without eggs (USFWS).

Hatching success. Number of chicks hatched/ number of eggs laid.

Fledgling. A chick that attains a minimum weight of 500 grams and is not found dead during the mortality count.

Fledging success. Number of chicks fledged/ number of chicks hatched.

Reproductive success. Number of chicks fledged per number of eggs laid.

Productivity. Number of chicks fledged per nest attempt.

Phenology

On Santa Barbara Island, the breeding season extended from early May through mid-August (egg laying to fledging) in 1991 (Figure 21). A shorter season followed in 1992 with early May laying extending to fledging in early August. On East Anacapa Island, egg laying began in mid-April in both 1991 and 1992 and continued through early or mid-August (Figure 21).

The early May start for gulls on Santa Barbara Island is late compared to mid- to late-April egg laying dates in previous years (Hunt and Ingram 1982). In 1992, events were very short on Santa Barbara Island while they were prolonged on East Anacapa. Egg laying was especially long on Anacapa, lasting 2.5 months. The brief fledging period on Santa Barbara Island was partly a result of relatively few chicks fledging on that island.

Total Nest Count

Both CHIS and USFWS counted total nests in 1991. Census areas are shown in Figure 22. CHIS counted birds sitting on nests just after hatch initiation from island observation points. Two groups of two observers each completed counts simultaneously, except in Area 9 (Figure 22) where three observers counted. USFWS counted nests by walking through accessible nesting areas and counting nests on cliffs from a small boat. This effort required four days (not counting transportation time to the island) with nine experienced observers. Detailed accounts of methods are in Carter et al. (1992).

Total nests counted in 1991 were 2,450 and 3,502 by CHIS and USFWS respectively (Table 14). This fairly large discrepancy is likely due to different census methods and different coverage of the island. USFWS included 490 nest bowls encountered without eggs, whereas CHIS counted birds sitting on nests (empty bowls are therefore excluded). Additionally, USFWS counted all cliff-nesting gulls while CHIS, counting from island vantage points, excluded most of these areas (Figure 22).

In 1992, counts were begun too late in the season to determine total nests from incubating birds. Therefore, CHIS used a correction factor based on nests with eggs (birds sitting) and nests with chicks (birds not sitting) from the sample reproduction grids (n=117 nests). We determined 40% of nests had chicks and 60% had eggs. The following formula was used to estimate total nests: x = birds sitting + $0.4(x)$, where x = total nests, and birds sitting on nests can be counted. We estimated 2,090 total nests in 1992 (Table 14).

Nesting Success

In 1991, more Santa Barbara Island gulls nested in the grids than in 1992 (167 and 117 nests respectively) (Tables 15, 16). On Anacapa slightly fewer gulls nested in 1991 than in 1992 (62 and 72 nests respectively). However, on both islands, gulls fledged more chicks in 1991 than in 1992: 217 and 73 on Santa Barbara Island and 116 and 80 on Anacapa Island respectively.

Clutch size, hatching success, fledging success, reproductive success, productivity, and chick growth rates were higher in 1991 than in 1992 for gulls on both islands with a few exceptions (clutch size and hatching success for Anacapa gulls were comparable between years) (Tables 17, 18). Hatching and fledging success for gulls on Santa Barbara Island were especially low in 1992, leaving the number of chicks fledged per nest attempt at 0.62 ± 0.77 compared to 1.30 ± 0.98 in 1991.

On East Anacapa Island, poor fledging success in 1992 brought overall productivity down to 1.11 ± 0.90 compared to a high fledging rate in 1991 and the resulting high productivity of 1.87 ± 0.91 (Tables 17, 18). Poor fledging success on Anacapa in 1992 was the result of chicks starving over a period of weeks as evidenced by the extremely low growth rates of 16.19 ± 5.45 grams per day and high numbers of large dead chicks. On Santa Barbara Island, poor fledging success was due primarily to many chicks dying at a very young age (possibly abandoned just after hatching) rather than from prolonged starvation.

In 1992, we observed several anomalies not noted in 1991. A total of 10 chicks (five on each island) died while pipping or during hatching. The cause of this kind of mortality is not known. In addition, one chick on Anacapa was born with a deformity of the ankle joint and was unable to fully extend the leg. The sibling was normal. The deformed chick died at six weeks of age from starvation.

Western Gull reproductive effort has continued to increase on Santa Barbara Island since 1984 with slightly over 1,000 nest attempts in that year to over 2,000 in 1992 (Figure 23). Productivity, based on samples, has decreased from over 1.5 to below 1.0 during the period 1985 to 1992.

Foods

Food samples were collected and identified from chicks that regurgitated while being weighed. In 1991, sixteen (16) samples from Santa Barbara Island and seventeen (17) samples from East Anacapa Island were collected, preserved, and later identified. In 1992, twelve (12) samples from Santa Barbara Island and ten (10) from East Anacapa Island were identified in the field. Small sample sizes for individual food categories and the relatively large unidentified-fish category make these results difficult to interpret (Table 19).

Combining food types for both islands may be more useful (Table 20). Between years, the amount of fish, mammalian tissue (fat or placentae), and garbage delivered to chicks is very similar. The major difference is the decrease in invertebrates (mainly squid) in the 1992 diet.

XANTUS' MURRELET *(Synthliboramphus hypoleuca)*

Xantus' Murrelets are listed as a Category 2 species with the U.S. Fish and Wildlife Service. Category 2 candidates for listing are species for which existing information indicates listing may be warranted, but more biological data are necessary to make a determination. The largest known colony of breeding Xantus' Murrelets is on Santa Barbara Island with an estimated breeding

population of fewer than 2,000 birds (Carter et al. 1992).

Murrelet reproduction was monitored on Santa Barbara Island in 1991 and 1992 in two areas where nesting density is high and nests are accessible. These areas are the Nature Trail (Site 1) and Cat Canyon (Site 2; Figure 24).

In 1991, nests were checked 12 times between late March and late June. Intervals between nest checks ranged from four to 16 days. In 1992, nest sites were checked 17 times between late February and early July. Intervals between visits ranged between three and eight days once egg laying was initiated.

Ideally, nests should be checked at least once weekly through the hatching phase to determine egg fates. However, transportation and staffing problems sometimes preclude maintaining this schedule. More frequent nest checks were possible in 1992 by having a volunteer living on the island from March through June.

Definition of Terms

Nest attempt. A monitored site where at least one egg is laid.

Hatched egg. Determined from eggshell fragments (membrane is loosely attached and dull; there are no yolk remains or tooth marks) or presence of chicks.

Broken egg. Determined from eggshell fragments (membrane is adherent to inner shell surface and shiny; often contain parts of yolk or clumps of dirt).

Productivity. Estimated as number of hatched eggs (minus number of dead chicks found in the colony) per nest attempt. Chicks go to sea two or three days after hatching. Actual survival rate to fledging age is unknown.

Phenology

Murrelets began nesting much later in 1992 (mid-April) than in 1991 (mid-March) (Figure 25). Hatching was complete by mid- to late- June in 1991 and in early July in 1992. Hatching probably would have extended well into July in 1992 if the majority of eggs had not been lost to predation earlier in the season.

Nesting Success

Of 125 nest sites monitored in 1991, there were 79 nest attempts (Table 21). In 1992, 126 sites were monitored and 76 of those received eggs (Table 21). There were more two-egg clutches in 1991 (mean clutch size = 1.60) than in 1992 (mean clutch size = 1.27) (Tables 22, 24).

The most vulnerable period of the breeding cycle is during the egg phase as there is no nestling phase for murrelets. Hatching success was lower in 1992 (mean = 36% at Nature Trial and 29% at Cat Canyon) compared to 1991 (mean=51% and 50% at each site, respectively) (Tables 22, 24). Pro-ductivity was also considerably lower in 1992 (mean=41% at Nature Trail and 42% at Cat Canyon) compared to 1991 (mean = 81% and 92%, respectively) (Tables 22, 24).

Egg mortality is primarily the result of predation by mice (*Peromyscus maniculatus*) that are endemic to the island. Even in a "good" year, mice take a heavy toll on unattended eggs. Eggs are not incubated until both eggs are laid, leaving the first egg exposed for about a week. However, in 1992, both eggs were frequently left unattended by parents, who may have been forced to travel far from the colony in search of food in scarce supply.

Murrelets have been monitored on Santa Barbara Island for the past 10 years. Considering both sample areas, average nest attempts per monitored site has varied from 42% at Nature Trail in 1992 to 85% at Cat Canyon in 1984 (Figure 26). Nest attempts at Nature Trail are more variable than at Cat Canyon as indicated by the relatively wide confidence interval. A potential source of this variability may be due to loss of nesting habitat at this site. Most of the nest sites at Nature Trail are on the ground underneath small shrubs *(Erio-phyllum nivosus).* However, due to persistent drought conditions, several plants have died and many others produced few leaves. Thus, murrelets are forced to either use low quality nest sites (with little or no cover) or find more suitable ones elsewhere.

Productivity has also been variable at both monitored sites (Figure 26). The highest mean productivity estimated was 1.36 at Nature Trail in 1989; the lowest mean productivity was 0.37 at Cat Canyon in 1990.

CASSIN'S AUKLET
(Ptychoramphus aleuticus)

We monitored 50 nest boxes (25 at two sites) on Prince Island in 1991 and 1992 (Figure 27). Three visits were made in 1991 (two by USFWS) and four visits were made in 1992. Since there is often a large time gap between visits of longer than one month (usually due to unfavorable weather conditions and understaffing), some of the information presented is based on the presence and type of eggshell fragments, nest box contents from the previous visit, and incubation and fledging periods known for Cassin's Auklets at the Farallon Islands, California (Ainley and Boekelheide 1990).

Definition of Terms

Nest attempt. A nest box in which an egg is laid. If an egg is broken and a replacement clutch is laid, the second clutch is counted as a separate nest attempt.

Hatching success Determined by the number of chicks present; occasionally determined by the presence and type of eggshell fragments (as for Xantus' Murrelets).

Fledging success. Number of chicks fledged per hatched egg. A chick is assumed fledged if the box is empty and it weighed at least 100 grams on the previous visit.

Productivity. Number of chicks fledged per nest attempt.

Phenology

There was a marked difference in the timing of breeding between 1991 and 1992. In 1991, egg laying took place from late March through mid-May followed by fairly long hatching and nestling periods. Fledging was complete by mid-August (Figure 28). In 1992, laying began a full month later—in late April—and continued for only one month through late May.

Similarly, hatching and fledging intervals were short, with fledging complete by the middle of August. Carter et al. (1992) estimated timing of breeding of Cassin's Auklets in Southern California in 1991 based on incubation patch condition of 141 birds captured in mist nets at four colonies. Their depiction of ranges of breeding phenology was almost identical to that found in nest boxes.

Nesting Success

There were 42 and 39 total nest attempts in 1991 and 1992 respectively, including one pair that laid after egg loss early in the 1992 season (Table 25). Nest box occupancy was 84% (42 of 50) in 1991 and 76% (39 of 50) in 1992.

Hatching success varied between years as well as between sites in the same year (Table 25). Unsuccessful hatches were usually the result of abandonment rather than predation (abandoned eggs were intact and unattended by an adult; eggs lost to predation by mice were identified by eggshell fragments as for Xantus' Murrelets). Reasons for within-year site differences are not known. Higher hatching success and fledging success in 1992 resulted in higher overall productivity (0.80 ± 0.40) than in 1991 (0.68 ± 0.47). By delaying the onset of breeding in 1992, auklets may have avoided a period of food scarcity early in the season, and thus were able to raise chicks successfully. No chick mortality was observed that year.

SNOWY PLOVER
(Charadrius alexandrinus nivosus)

The western subspecies of snowy plover (*Charadrius alexandrinus nivosus*) was listed in February, 1993, as threatened by the U.S. Fish and Wildlife Service. Point Reyes Bird Observatory (PRBO) monitors Snowy Plovers on San Miguel and Santa Rosa Islands as part of a Memorandum of Understanding with CHIS. CHIS assisted PRBO with monitoring of plovers in 1992.

In 1992, CHIS also contracted with PRBO to study nesting distribution, habitat use, and nesting success of plovers breeding on a portion of Santa Rosa Island during the 1992 breeding season. This represents the first attempt to ascertain information on nesting success for plovers on the islands—a crucial piece of information in determining population status.

All suitable beach habitat on each island was surveyed for breeding adults, nests, and chicks on time in both years during the peak period of nesting activity. In 1991, censuses were conducted May 25–29. In 1992, censuses were conducted May 5–9. Most of the monitoring effort is dedicated to counting adults as nests are extremely difficult to locate.

San Miguel Island. Small numbers of plovers nested on San Miguel Island in 1991 and 1992. Total number of breeding adults for the entire island was 19 and 23 respectively (Figure 29; Tables 26, 27). The small increase in birds in 1992 is apparently due to increased use of Sites 6 and 7 (Cardwell Spit and Glass Ball Beach) and the addition of Site 3 (Range Pole Beach) as a census area (Figure 29). There was also decreased use of Site 2 (Simonton Cove) and Site 5 (Southeast Beaches) in 1992. Numbers of plovers breeding on San Miguel Island remain very low compared to numbers for the mid-1980's (Figure 31).

Santa Rosa Island. There were 103 and 115 breeding plovers on Santa Rosa Island in 1991 and 1992 respectively (Figure 30; Tables 25, 26). The additional birds in 1992 appear to be the result of increased nesting at Site 2 (Arlington) and Site 7 (Cluster Point) (Figure 30). The Skunk Point area (Site 8) remains the most important breeding area on this island. Over half the plovers nested at this location.

Since 1989, when monitoring began, the total breeding effort for plovers on Santa Rosa Island has remained relatively unchanged (Figure 31).

The 1992 PRBO study of plovers at Skunk Point revealed hatching success (eggs hatched per eggs laid) of 27%. Most of the egg losses were due to winds (covering or displacing eggs when a parent was off the nest) or sandblasting and raven predation. Two nests (6 eggs) were trampled by cattle. For details of this study, see Keimel (1992).

TUFTED PUFFIN
(Fratercula cirrhata)

In 1991, USFWS found Tufted Puffins nesting on the north cliffs of Prince Island (estimate: 10 breeding birds; Carter et al. 1992). This was the first confirmed observation of this species breeding at this colony since 1912. Tufted Puffins also nested historically at four other colonies in the Channel Islands (Carter et al. 1992). Recolonization at Prince Island may forecast recolonization at other colonies.

Puffins were not observed at nest sites in 1992, although one bird in breeding plumage was seen flying just off Prince Island on May 5. Fewer observations of puffins this year was probably due, at least in part, to the lower census effort for this species compared to the effort in 1991 by USFWS.

RHINOCEROS AUKLET
(Cerorhinca monocerata)

Rhinoceros Auklets were observed by USFWS in 1991 on Prince Island in breeding plumage, exhibiting courtship behavior and landing on the north cliffs. From these and other observations, Carter et al. (1992) estimated 15 breeding birds on Prince Island in 1991. It has been suspected for several years that this species may have been breeding on Prince Island (D.B. Lewis, pers. comm.) based on observations of birds in nearby waters. Rhinoceros Auklets were also observed on the water by Castle Rock (1 bird on 10 June) and between Harris Point and Cuyler Harbor on San Miguel Island (1 bird on 10 June; 3 birds on 12 July) during USFWS surveys in 1991 (see Carter et al. 1992).

These three nesting locations are the first solid documentation of breeding for this species in the Channel Islands. However, possible nesting at Santa Barbara Island was suspected in the late 1800's (Carter et al. 1992).

Two Rhinoceros Auklets in breeding plumage were seen at Prince Island on May 6, 1992. A special effort to census this species in 1992 was not possible.

DISCUSSION

Seabirds are extraordinary birds. Incredibly hardy yet graceful, they are uniquely adapted to and dependent on ocean resources for their survival. Many species come ashore for only short periods each year when they gather at isolated islands to mate and raise young.

Seabirds have also proven to be highly sensitive and reliable biological indicators of the condition of the oceans. By monitoring seabirds at their breeding colonies, we become privy to a host of information on ocean productivity and pollution that would otherwise be unavailable and, therefore, unmanageable.

The monitoring results for 1991 and 1992 in the Channel Islands exemplify seabirds as indicators of ocean productivity. In 1991, we saw increases in nesting effort and nesting success for most of the monitored species as well as some species range expansions. Normal weather patterns and temperatures were noted this year

and important seabird prey species were presumably abundant.

In contrast, we witnessed severe El Niño conditions in 1992. This was characterized by sea surface temperatures ranging from 3–6 degrees centigrade above normal between February and June and a breakdown of usual ocean circulation patterns and upwelling. For seabirds and other higher level marine predators, these conditions probably resulted in food scarcity.

From the resulting energetic stress, seabirds may have been forced to use one of several strategies in an effort to maximize lifelong reproductive success. At some colonies, many simply did not attempt to breed (low reproductive effort was observed in all species). Some species abandoned their young before fledging occurred (Brown Pelican, Double-Crested and Pelagic Cormorants) or raised malnourished chicks that died before fledging (Western Gull). Cassin's Auklets and Xantus' Murrelets delayed breeding, a strategy that benefitted the auklets but not the murrelets.

The severity of the food shortage in 1992 is perhaps best illustrated by the responses displayed by Western Gulls, Brown Pelicans, and Brandt's Cormorants. As extreme food generalists, gulls are known to include a wide variety of food types in their diet. However, despite their ability to take advantage of multiple food sources, we documented gull fledging rates of less than 50% due largely to chick starvation.

On the other hand, Brown Pelicans are known to be diet specialists and should tend to be more strongly affected by environmental changes. We observed pelican chicks die at nest sites when parents were unable to locate prey. We also observed emaciated, dead or dying adult birds on mainland beaches. The death of adult birds in addition to chicks is indicative of severe food shortages.

Interestingly, even a short-lived disruption in food availability in *good* years—such as 1991—can result in as much nesting failure for pelicans as in *bad* years. Adults were unable to find enough food in March, 1991, due to severe and continuous storms during that month shortly after egg laying began. This transient event was largely responsible for nearly as much nest abandonment (over 75%) as occurred in 1992 when food supplies were scarce for a much longer period of time.

Brandt's Cormorants, although not a monitored species, were highly sensitive to between-year oceanic differences. In 1991, 2,500 pairs nested at the Bay Point colony site on San Miguel Island (Carter et al. 1992). In 1992, they did not attempt to nest at all at this location (USFWS, unpubl. data).

The CHIS Seabird Monitoring Program continues to provide useful information for resource protection to park managers and other interested organizations and the public. Because seabirds are highly sensitive to changing environmental condi-tions and often respond very quickly to detrimental changes, they remain, as a group, one of the most reliable indicators of ecosystem health.

MANAGEMENT ISSUES

Several management issues have been a concern since seabird monitoring began nearly eight years ago. In addition, we have become aware of other issues from the data obtained by the 1991 USFWS surveys of Southern California colonies.

These surveys also provided information that put the Channel Islands on the *seabird map*. We now know the relative importance of these colonies compared to seabird colonies in Central and Northern California and on the west coast of North America.

EXPAND CHIS SEABIRD MONITORING PROGRAM

We recommend that the monitoring program be expanded in several key areas.

First

The Prince Island / San Miguel Island area which is used by 12 of the 13 seabird species that breed in the Channel Islands needs more study. Specifically, for Cassin's Auklets, once per month visits as is currently called for in the Seabird Monitoring Handbook result in data of marginal quality. And, if one of the scheduled monitoring visits is missed, data on nesting success may be lost. We recommend visits twice per month for monitoring Cassin's Auklets.

In addition, to incorporate observations of Rhinoceros Auklets and Tufted Puffins at Prince Island, more time is required per visit. We recommend one additional day per monitoring visit for this purpose. This would result in increasing actual monitoring time to two full days per visit (not counting transportation time).

Second

The inclusion of Brandt's Cormorants as a monitored species should be investigated. Brandt's Cormorants are the most abundant breeding seabird species in the Channel Islands (Carter et al. 1992). They are also very sensitive to environmental changes, and are the primary species monitored by the San Nicolas Island Seabird Monitoring Program.

Third

Additional work is required to refine population estimates for Brown Pelicans from aerial photographs or airborne video. The work on aerial photography as a census technique begun in 1991 needs to be completed.

Fourth

Monitoring should include periodic total population surveys of all species in the Channel Islands. These would provide needed information on population trends not available from sampling reproductive success. They would also provide data for difficult-to-census species such as the storm-petrels. We recommend surveys at five year intervals beginning in 1996.

APPLIED RESEARCH

In order to make informed management decisions, monitoring is not enough. We also need answers to specific questions that can only be obtained through applied research. Important research topics include the following:

First

A better understanding of disturbance tolerances of sensitive species that are likely to be adversely impacted by increasing visitation near nest sites (especially Pelagic Cormorants, Brandt's Cormorants, Pigeon Guillemots) and roost sites (especially Brown Pelicans, Brandt's Cormorants) is badly needed.

Second

The ecology of rare, declining, or candidate species such as Xantus' Murrelets and Ashy Storm-petrels is needed. Santa Barbara Island is the largest known nesting colony for murrelets with fewer than 2,000 breeding birds. The worldwide population may be as low as 5,000. The small size of the population, its restricted range, low breeding success, and vulnerability to potential oil spill damage has caused great concern for this species.

Third

Species already listed as threatened or endangered require more attention. For example, to understand the population status of Snowy Plovers, we need to continue studies on nesting success on Santa Rosa Island, investigate reasons for the decline on San Miguel Island, and ascertain movement patterns within and between islands and to and from the mainland. The Channel Islands may harbor the last protected sites available for this species.

FOCUS ON DATA MANAGEMENT

Data Management for the CHIS Seabird Monitoring Program requires substantially more attention than it has thus far received. In particular, the following areas need to be addressed:

First

Methods to ensure consistency of data collection between years.

Second

Consistency of data collection methods and data analysis between the CHIS Seabird Monitoring Program and other related seabird monitoring programs, especially the San Nicolas Island Seabird Monitoring Program. Close coordination between these programs is needed to produce comparable data for Brandt's Cormorants and Western Gulls.

Third

Use of geographically-referenced data through GIS, GPS (global positioning system), and aerial photography and/or videography.

Fourth

Begin investigating techniques for trend analysis for species with existing large databases (Brown Pelicans, Double-Crested Cormorants) especially with respect to monitoring and management goals.

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TABLES 1–29

FAMILY	SPECIES	ISLAND				
		ANI	SBI	SCI	SMI	SRI
Alcids Alcidae	*Cassin's Auklet (*Ptychoramphus aleuticus*)	H	A	A	L	
	Pigeon Guillemot (*Cepphus columba*)	A	A	L	A	A
	Rhinoceros Auklet (*Cerorhinca monocerata*)			F		
	Tufted Puffin (*Fratercula cirrhata*)	H	H	H	R	
	*Xantus' Murrelet (*Synthliboramphus hypoleuca*)	A	L	A	A	
Cormorants Phalacrocoracidae	*Brandt's Cormorant (*Phalacrocorax penicillatus*)	O	A	A	L	A
	*Double-Crested Cororant (*P. auritus*)	A	L	H	A	
	*Pelagic Cormorant (*P. pelagicus*)	A	O	A	A	L
Gulls Laridae	*Western Gull (*Larus occidentalis*)	L	A	A	A	A
Pelicans Pelecanidae	*California Brown Pelican (*Pelecanus occidentalis californicus*)	L	A	O	H	
Storm Petrels Hydrobatidae	Ashy Storm-Petrel (*Oceanodroma homochroa*)	?	A	A	L	?
	Black Storm-Petrel (*O. melania*)	?	L	?	P	?
	Leach's Storm-Petrel (*O. leucorhoa*)	?	L	?	A	?

Table 1. Distribution of seabirds in Channel Islands National Park (after Hunt et al. 1980 & Carter et al. 1992)

*Monitored Species

LEGEND

Island

ANI = Anacapa Island
SBI = Santa Barbara Island, including Sutil Island and Shag Rock
SCI = Santa Cruz Island, including Gull Island, Scorpion Rock, and Willows Anchorage Rock
SMI = San Miguel Island, including Prince Island and Castle Rock
SRI = Santa Rosa Island

Distribution

A = Active colony
F = First documented breeding
H = Historical nesting
L = Largest colony
O = Occasional colony
P = Present
R = Re-colonization effort

? = Probably present

ISLAND	SPECIES	CHIS	GRESS	USFWS	PRBO	TOTAL DAYS	TOTAL PERSON-DAYS
1991							
ANI	BRPE	3 (1.0)	44 (1.0)			47	47.0
	DCCO						
	PECO						
	WEGU repo.	8 (1.5)				8	9.5
SBI	BRPE	44 (2.0)				58	176.0
	DCCO			8 (5.0)			
	WEGU repo.						
	XAMU			6 (8.0)			
	WEGU total	2 (7.0)		6 (9.0)		8	68.0
PI	CAAU	5 (2.0)		6 (4.0)		19	58.0
	DCCO			8 (3.0)			
SMI	SNPL	3 (1.0)		0	3 (2.0)	6	9.0
SRI	SNPL	4 (1.0)		0	4 (2.0)	8	12.0
TOTAL		**69**	**44**	**34**	**7**	**154**	**379.5**
1992							
ANI	BRPE	2 (1.0)	30 (1.0)			32	32.0
	DCCO						
	PECO						
	WEGU repo.	9 (1.5)				9	13.5
SBI	BRPE	57 (2.5)				57	135.0
	DCCO						
	WEGU repo.						
	XAMU						
	WEGU total	2 (2.0)				2	4.0
PI	CAAU	12 (2.0)				12	24.0
	DCCO						
SMI	SNPL	2 (2.0)			2 (2.0)	4	8.0
SRI	SNPL	3 (2.0)			2 (2.0)	5	10.0
TOTAL		**87**	**30**		**4**	**121**	**226.5**

Table 2. Seabird Monitoring effort in Channel Islands National Park, 1991–1992.

LEGEND

Island

ANI = Anacapa Island
SBI = Santa Barbara Island, including Sutil Island and Shag Rock
SMI = San Miguel Island
SRI = Santa Rosa Island
PI = Prince Island

Species

BRPE = Brown Pelican
DCCO = Double-Crested Cormorant
PECO = Pelagic Cormorant
WEGO = Western Gull
XAMU = Xantus' Murrelet
CAAU = Cassin's Auklet
SNPL = Snowy Plover

AREA	SUBCOLONY NAME	NEST ATTEMPTS	NESTS ABANDONED	NESTS SUCCESSFUL	YOUNG FLEDGED	PRODUCTIVITY	MORTALITY
1	Three Sisters Bluff	1,010	889	121	132	0.13	2
2	North Bluff	232	163	69	108	0.47	3
3	Oak Canyon	489	360	129	220	0.45	18
4	Oak Canyon Bluff	254	201	53	59	0.23	15
5	Summit Canyon	143	105	38	50	0.35	6
6	Summit Canyon Bluff	419	344	75	87	0.21	11
7	Box Canyon	135	91	44	56	0.41	11
8	West Interior Bluff	403	347	56	88	0.22	10
9	Willow Canyon	97	52	45	70	0.72	3
10	Middle Interior Bluff	370	291	79	102	0.28	13
11	Canyon por Nada	163	124	38	65	0.40	8
12	East Interior Bluff	251	188	63	82	0.33	15
13	Cherry Canyon	180	142	38	47	0.26	6
14	Camel Ridge Bluff	32	22	10	14	0.44	(2)
15	Amphitheater	1,587	1,228	359	422	0.27	(45)
TOTAL		**5,765**	**4,547**	**1,218**	**1,602**	**0.28**	**168**

Table 3. Reproduction in California Brown Pelicans on West Anacapa Island, 1991 (F. Gress, unpubl. data).

( ) denotes estimated values

AREA	SUBCOLONY NAME	NEST ATTEMPTS	NESTS ABANDONED	NESTS SUCCESSFUL	YOUNG FLEDGED	PRODUCTIVITY	MORTALITY
1	Three Sisters Bluff	0	0	0	0	0	0
2	North Bluff	0	0	0	0	0	0
3	Oak Canyon	0	0	0	0	0	0
4	Oak Canyon Bluff	0	0	0	0	0	0
5	Summit Canyon	0	0	0	0	0	0
6	Summit Canyon Bluff	136	116	20	24	0.18	4
7	Box Canyon	146	102	44	51	0.35	43
8	West Interior Bluff	190	170	20	19	0.10	13
9	Willow Canyon	28	22	6	6	0.21	1
10	Middle Interior Bluff	140	112	28	35	0.25	11
11	Canyon por Nada	130	104	26	30	0.23	12
12	East Interior Bluff	162	103	59	67	0.41	28
13	Cherry Canyon	106	68	38	43	0.41	29
14	Camel Ridge Bluff	0	0	0	0	0	0
15	Amphitheater	448	356	92	97	0.21	(48)
TOTAL		**1,486**	**1,153**	**333**	**372**	**0.25**	**189**

Table 4. Reproduction in California Brown Pelicans on West Anacapa Island, 1992 (F. Gress, unpubl. data).

( ) denotes estimated values

AREA	SUBCOLONY NAME	TOTAL NESTS	NESTS ABANDONED	NESTS SUCCESSFUL	YOUNG FLEDGED	PRODUCTIVITY	MORTALITY #	MORTALITY %
1	Graveyard Canyon Area	273	225	48	75	0.29	7	8.54
2	Sea Lion Rookery	195	126	69	63	0.32	1	1.56
3	Slope North of Cat Canyon	80	64	16	21	0.26	1	4.55
4	West Cliffs	5	3	2	2	0.40	0	0
5	Signal Peak Slope	65	43	22	26	0.40	1	3.70
6	Erosion Gullies	0	0	0	0	0.00	0	0
TOTAL		**618**	**461**	**157**	**187**	**0.31**	**10**	**3.67 (±1.49)**

Table 5. Reproduction in Brown Pelicans on Santa Barbara Island, 1991 (CHIS Seabird Monitoring Program).

AREA	SUBCOLONY NAME	TOTAL NESTS	NESTS ABANDONED	NESTS SUCCESSFUL	YOUNG FLEDGED	PRODUCTIVITY	MORTALITY #	MORTALITY %
1	Graveyard Canyon Area	45	42	3	2	0.04	9	81.8
2	Sea Lion Rookery	18	16	2	2	0.11	3	60.0
3	Slope North of Cat Canyon	8	6	2	3	0.38	0	00.0
4	West Cliffs	23	19	4	2	0.09	3	60.0
5	Signal Peak Slope	13	11	2	1	0.08	1	50.0
6	Erosion Gullies	159	143	16	12	0.08	7	36.8
TOTAL		**266**	**237**	**29**	**22**	**0.08**	**23**	**48.1 (±27.8)**

Table 6. Reproduction in Brown Pelicans on Santa Barbara Island, 1992 (CHIS Seabird Monitoring Program).

	TOTAL IN COLONY	TOTAL IN SAMPLE[1]	MEAN ± S.D.
NESTS ATTEMPTED			
With countable chicks		98	8.91 ± 9.66
With incubating or brooding adult	230	160	12.31 ± 12.49
Abandoned	(33)	26 [9.2%]	2.17 ± 2.66
TOTAL	**360**	**284**	
FLEDGLINGS[2]	(587)	175	
PRODUCTIVITY[3]			
Sample			1.79 ± 0.31
Colonywide			(1.63 ± 0.45)

Table 7. Reproduction in Double-Crested Cormorants on West Anacapa Island, 1991 (F. Gress, unpubl. data)

( ) Denotes estimated values

[1]n = 11 subcolonies

[2] Fledglings, colonywide: Total nest attempts x colonywide productivity.

[3] Productivity

Sample = Sample chicks fledged/sample nests with chicks.

Colonywide = Sample productivity x sample nests with incubating or brooding adult + chicks fledged in sample/nests

in sample.

	TOTAL IN COLONY	TOTAL IN SAMPLE[1]	MEAN ± S.D.
NESTS ATTEMPTED			
With countable chicks		42	13.67 ± 10.60
With incubating or brooding adult	154	77	24.67 ± 5.51
Abandoned	(66) [25.2%]	35	11.67 ± 3.51
TOTAL	**263**	**155**	
FLEDGLINGS[2]	(300)	62	
PRODUCTIVITY[3]			
Sample			1.51 ± 0.15
Colonywide			(1.16 ± 0.15)

Table 8. Reproduction in Double-Crested Cormorants on West Anacapa Island, 1992 (F. Gress, unpubl. data)

( ) Denotes estimated values

[1]n = 3 subcolonies

[2] Fledglings, colonywide: Total nest attempts x colonywide productivity.

[3] Productivity

Sample = Sample chicks fledged/sample nests with chicks.

Colonywide = Sample productivity x sample nests with incubating or brooding adult + chicks fledged in sample/nests

in sample.

	TOTAL IN COLONY		TOTAL IN SAMPLE[1]
	GROUND	AERIAL	GROUND
NESTS ATTEMPTED			
With countable chicks			22
With incubating or brooding adult	229		14
Abandoned			5 [12.2%]
TOTAL	**262**	**509[2]**	**41**
FLEDGLINGS[3]	(450)	(875)	41
PRODUCTIVITY[4]	(1.72)		1.86

Table 9. Reproduction in Double-Crested Cormorants on Santa Barbara Island, 1991 (CHIS Seabird Monitoring Program).

( ) Denotes estimated values

[1] n = 1 subcolony

[2] Includes 13 additional nests from Site 1 (Figure 11) from ground count.

[3] Fledglings = Total nest attempts x colonywide productivity.

[4] Productivity

Sample = Sample chicks fledged/sample nests with chicks.

Colonywide = Sample productivity x sample nests with incubating or brooding adult + chicks fledged in sample/nests

in sample.

	TOTAL IN COLONY	TOTAL IN SAMPLE[1]	MEAN ± S.D.
NESTS ATTEMPTED			
With countable chicks	---	30	2.73 ± 4.56
With incubating or brooding adult	98	19	1.73 ± 3.50
Abandoned	---	32 [39.5%]	2.91 ± 5.39
TOTAL	**193**	**81**	
FLEDGLINGS[2]	(201)	48	
PRODUCTIVITY[3]			
Sample			1.68 ± 0.38
Colonywide			(1.04 ± 0.28)

Table 10. Reproduction in Double-Crested Cormorants on Santa Barbara Island, 1992 (CHIS Seabird Monitoring Program).

( ) Denotes estimated values

[1]n = 11 subcolonies

[2] Fledglings, colonywide: Total nest attempts x colonywide productivity.

[3] Productivity

Sample = Sample chicks fledged/sample nests with chicks.

Colonywide = Sample productivity x sample nests with incubating or brooding adult + chicks fledged in sample/nests

in sample.

	TOTAL IN COLONY		TOTAL IN SAMPLE		MEAN ± S.D.	
	1991	1992	1991	1992[1]	1991	1992
NESTS ATTEMPTED						
With countable chicks	ND	---	ND	26		2.17 ± 3.27
With incubating or brooding adult	ND	33	ND	16		1.33 ± 2.19
Abandoned	ND	---	ND	19 [31%]		1.58 ± 3.75
TOTAL	**230**	**107**		**61**		
FLEDGLINGS[2]	ND	(123)	ND	35		
PRODUCTIVITY[3]						
Sample	ND		ND			1.41 ± 0.40
Colonywide						(1.15 ± 0.50)

Table 11. Reproduction in Double-Crested Cormorants on Prince Island, 1991 (Carter, et al), 1992 (CHIS Seabird Monitoring Program).

ND = In 1991, data for chicks and successful nests was Not Determined.

( ) Denotes estimated values

[1] n = 12 subcolonies

[2] Fledglings, colonywide: Total nest attempts x colonywide productivity.

[3] Productivity

Sample = Sample chicks fledged/sample nests with chicks.

Colonywide = Sample productivity x sample nests with incubating or brooding adult + chicks fledged in sample/nests in sample.

	WEST ANACAPA			MIDDLE ANACAPA			EAST ANACAPA			TOTAL
	TOTAL	[1]SAMPLE	MEAN ± S.D.	TOTAL	[1]SAMPLE	MEAN ± S.D.	TOTAL	SAMPLE[1]	MEAN ± S.D.	
Nests Attempted										
With countable chicks		27	3.86 ± 2.27		7			24	6.00 ± 3.92	
With incubating or brooding adults	28	27	3.38 ± 2.50		6		10	8	1.60 ± 1.52	
Abandoned		2			0			0		
TOTAL	**64**	**56**		**38**	**13**		**34**	**32**		**152**
Fledglings[2]	(103)	52		(82)	16		(62)	49		(301)
Productivity[3]										
Sample			1.80 ± 0.43			2.17 ±0.24			1.89 ± 0.33	
Colonywide			(1.61 ± 0.44)			(2.17 ± 0.24)			(1.89 ± 0.33)	(1.98 ± 0.41)

Table 12. Reproduction in Pelagic Cormorants on Anacapa Island, 1991 (F. Gress, unpubl. data; Carter et al. 1992).

( ) Denotes estimated values

[1] n = 8 (West Anacapa); n = 2 (Middle Anacapa); n = 5 (East Anacapa)

[2] Fledglings = Total nest attempts x colonywide productivity. Assumes no nest abandonment after survey dates.

[3] Productivity

Sample = Sample chicks fledged/sample nests with chicks.

Colonywide = Sample productivity x sample nests with incubating or brooding adult + chicks fledged in sample/nests in sample.

	TOTAL IN COLONY	TOTAL IN SAMPLE[1]	MEAN ± S.D.
NESTS ATTEMPTED			
With countable chicks		15	1.36 ± 2.01
With incubating or brooding adult	22	8	1.14 ± 1.57
Abandoned	11	3	
TOTAL	**48**	**26**	
FLEDGLINGS[2]	(76)	27	
PRODUCTIVITY[3]			
Sample			1.80 ± 0.38
Colonywide			1.58

Table 13. Reproduction in Pelagic Cormorants on Anacapa Island, 1992 (F. Gress, unpubl. data).

( ) Denotes estimated values

[1]n = 7 subcolonies (1 from East Anacapa, 6 from West Anacapa).

[2] Fledglings, colonywide: Total nest attempts x colonywide productivity.

[3] Productivity

Sample = Sample chicks fledged/sample nests with chicks.

Colonywide = Sample productivity x sample nests with incubating or brooding adult + chicks fledged in sample/nests

in sample.

SUBCOLONY AREA	SUBCOLONY NAME	NESTS	
		1991	1992
1	Landing Cove	57	22
2A	Arch Point	65	42
2B	Upland Cliff Canyon	50	17
3	Shag Rock	87	23
4	Elephant Seal Cove	77	99
5	North Cliff	25	33
6	Webster Point	160	91
7	Al Cliff	50	8
8	Al Area	70	46
9	West Colony	1139	844
10	Badlands	170	239
11	Cat Canyon Area	193	219
12	Sea Lion Rookery	307	407
TOTAL		**2450**	**2090**

Table 14. Total nest count for Western Gulls on Santa Barbara Island, 1992–1992 (CHIS Seabird Monitoring Program; Carter et al. 1992)

ISLAND	GRID	NESTS	EGGS LAID	EGGS HATCHED	CHICKS FLEDGED
Santa Barbara	A	40	99	74	63
	D	51	111	74	70
	E	76	167	118	84
Total		**167**	**377**	**266**	**217**
East Anacapa	A	28	75	60	46
	B	34	95	87	70
Total		**62**	**170**	**147**	**116**

Table 15. Reproduction in Western Gulls on Santa Barbara and East Anacapa Islands, 1991 (CHIS Seabird Monitoring Program).

ISLAND	GRID	NESTS	EGGS LAID	EGGS HATCHED	CHICKS FLEDGED
Santa Barbara	A	31	65	47	18
	D	32	65	34	20
	E	54	115	64	35
Total		**117**	**245**	**145**	**73**
East Anacapa	A	34	90	64	33
	B	38	106	96	47
Total		**72**	**196**	**160**	**80**

Table 16. Reproduction in Western Gulls on Santa Barbara and East Anacapa Islands, 1992 (CHIS Seabird Monitoring Program)

DATA MONITORED	SANTA BARBARA (Mean ± s.d.)	EAST ANACAPA (Mean ± s.d.)	T VALUE	P
Clutch Size	2.26 ± 0.70	2.74 ± 0.54	4.91	<0.01
Hatching Success	0.69 ± 0.38	0.87 ± 0.21	3.54	<0.01
Fledging Success	0.81 ± 0.34	0.81 ± 0.31	0.10	0.92
Reproductive Success	0.56 ± 0.40	0.69 ± 0.31	2.33	0.02
Productivity	1.30 ± 0.98	1.87 ± 0.91	4.00	<0.01
Growth Rates (Grams/Day)	24.05 ± 4.20	24.09 ± 4.81	0.05	0.96

Table 17. Summary of reproductive data in Western Gulls on Santa Barbara and East Anacapa Islands, 1991 (CHIS Seabird Monitoring Program).

DATA MONITORED	SANTA BARBARA (Mean ± s.d.)	EAST ANACAPA (Mean ± s.d.)	T VALUE	P
Clutch Size	2.10 ± 0.71	2.72 ± 0.54	6.48	<0.01
Hatching Success	0.59 ± 0.41	0.80 ± 0.34	3.62	<0.01
Fledging Success	0.50 ± 0.44	0.51 ± 0.35	0.11	0.92
Reproductive Success	0.29 ± 0.36	0.39 ± 0.31	1.92	0.56
Productivity	0.62 ± 0.77	1.11 ± 0.90	3.95	<0.01
Growth Rates (Grams/Day)	21.30 ± 6.01	16.19 ± 5.45	4.25	<0.01

Table 18. Summary of reproductive data in Western Gulls on Santa Barbara and East Anacapa Islands, 1992 (CHIS Seabird Monitoring Program).

ISLAND	FOOD	OCCURRENCE	
		1991	1992
Santa Barbara	Anchovy	0	6
	Sardine	0	0
	Squid	5	0
	Unidentified Fish	7	6
	Mammal Tissue	2	3
	Pelagic Red Crab	1	0
	Garbage	3	0
	Unidentified	0	2
TOTAL		**18**	**17**
East Anacapa	Anchovy	3	2
	Sardine	2	0
	Squid	3	1
	Unidentified Fish	6	3
	Mammal Tissue	3	0
	Pelagic Red Crab	1	3
	Garbage	0	1
	Unidentified	0	0
TOTAL		**18**	**10**

Table 19. Food samples from Western Gull chicks on Santa Barbara and East Anacapa Islands, 1991–1992 (CHIS Seabird Monitoring Program).

FOOD TYPE	1991	1992
Fish	18	17
Invertebrates	10	4
Mammal Tissue	5	3
Garbage	3	1
TOTAL	**36**	**25**

Table 20. Summary of food types from Western Gull chicks on Santa Barbara and East Anacapa Islands, 1991–1992 (CHIS Seabird Monitoring Program).

AREA	MONITORED NEST SITES	NEST ATTEMPTS	EGGS LAID	EGGS HATCHED	EGGS BROKEN
Nature Trail	51	22	35	18	17
Cat Canyon	74	57	93	49	44
TOTAL	**125**	**79**	**128**	**67**	**61**

Table 21. Reproduction in Xantus' Murrelets on Santa Barbara Island, 1991 (CHIS Seabird Monitoring Program).

DATA MONITORED	NATURE TRAIL (Mean ± s.d.)	CAT CANYON (Mean ± s.d.)	T VALUE	P
Nest Attempts/Monitored Site	0.43 ± 0.54	0.77 ± 0.63	3.33	<0.01
Clutch Size	1.60 ± 0.49	1.64 ± 0.46	0.39	0.70
Hatching Success	0.51 ± 0.42	0.50 ± 0.40	0.04	0.97
Egg Mortality	0.49 ± 0.42	0.50 ± 0.40	0.04	0.97
Productivity	0.81 ± 0.68	0.92 ± 0.76	0.57	0.57

Table 22. Summary of reproductive data in Xantus' Murrelets on Santa Barbara Island, 1991 (CHIS Seabird Monitoring Program).

AREA	MONITORED NEST SITES	NEST ATTEMPTS	EGGS LAID	EGGS HATCHED	EGGS BROKEN
Nature Trail	55	23	29	9	20
Cat Canyon	71	53	78	23	55
TOTAL	**126**	**76**	**107**	**32**	**75**

Table 23. Reproduction in Xantus' Murrelets on Santa Barbara Island, 1992 (CHIS Seabird Monitoring Program).

DATA MONITORED	NATURE TRAIL (Mean ± s.d.)	CAT CANYON (Mean ± s.d.)	T VALUE	P
Nest Attempts/Monitored Site	0.42 ± 0.53	0.75 ± 0.67	2.97	<0.01
Clutch Size	1.27 ± 0.46	1.45 ± 0.47	1.50	0.14
Hatching Success	0.36 ± 0.49	0.29 ± 0.40	0.67	0.51
Egg Mortality	0.64 ± 0.49	0.71 ± 0.40	0.67	0.51
Productivity	0.41 ± 0.59	0.42 ± 0.64	0.07	0.94

Table 24. Summary of reproductive data in Xantus' Murrelets on Santa Barbara Island, 1992 (CHIS Seabird Monitoring Program).

YEAR	SITE	NEST ATTEMPTS		HATCHING SUCCESS		FLEDGING SUCCESS		PRODUCTIVITY
		NUMBER	MEAN ± S.D.	EGGS HATCH	MEAN ± S.D.	CHICKS	MEAN ± S.D.	MEAN ± S.D.
1991	A	23	0.92 ± 0.40	19	0.76 ± 0.44	17	0.90 ± 0.32	0.77 ± 0.43
	B	19	0.76 ± 0.66	10	0.40 ± 0.50	10	1.00 ± 1.00	0.56 ± 0.48
TOTAL		**42**	**0.84 ± 0.55**	**29**	**0.58 ± 0.50**	**27**	**0.93 ± 0.26**	**0.68 ± 0.46**
1992	A	20	0.80 ± 0.41	14	0.56 ± 0.51	14	1.00 ± 0.00	0.70 ± 0.47
	B	19	0.76 ± 0.52	17	0.68 ± 0.48	17	1.00 ± 0.00	0.92 ± 0.26
TOTAL		**39**	**0.78 ± 0.47**	**31**	**0.62 ± 0.49**	**31**	**1.00 ± 0.00**	**0.80 ± 0.40**

Table 25. Reproduction in Cassin's Auklets in artificial nest boxes on Prince Island, 1991–1992 (CHIS Seabird Monitoring Program).

SITE #	SITE NAME	MALES	FEMALES	TOTAL ADULTS	JUVENILES	BROODS	NESTS
1	Cuyler Harbor	1	2	3	0	0	0
2	Simonton Cove	6	4	10	0	2	0
3	Range Pole Beach[1]	ND	ND	ND	ND	ND	ND
4	Bowl Cove	1	0	1	0		0
5	Southeast Beaches	3	1	4	0	1	1
6	Cardwell Spit	0	1	1	0	0	0
7	Glass Ball Beach	0	0	0	0	0	0
TOTAL		**11**	**8**	**19**	**0**	**3**	**1**

Table 26. Snowy Plovers on San Miguel Island, 1991 (PRBO, unpubl. data).

[1] Not surveyed in 1991

SITE #	SITE NAME	MALES	FEMALES	TOTAL ADULTS	JUVENILES	BROODS	NESTS
1	Cuyler Harbor	2	2	4	0	0	0
2	Simonton Cove	1	2	3	0	0	1
3	Range Pole Beach[1]	3	2	5	0	1	0
4	Bowl Cove	1	0	1	0	0	0
5	Southeast Beaches	0	0	0	0	0	0
6	Cardwell Spit	3	2	5	0	0	1
7	Glass Ball Beach	3	2	5	0	0	0
TOTAL		**13**	**10**	**23**	**0**	**1**	**2**

Table 27. Snowy Plovers on San Miguel Island, 1992 (PRBO, unpubl. data).

[1] Censused for the first time in 1992

SITE #	SITE NAME	MALES	FEMALES	TOTAL ADULTS	JUVENILES	BROODS	NESTS
1	Soledad Beach	2	2	4	0	0	0
2	Arlington Beach	1	1	2	0	0	0
3	Sandy Point	1	0	1	0	0	0
4	Mud Tank Beach	2	2	4	0	0	0
5	Bee Rock Beach	6	6	13	0	0	1
6	Whetstone Beach[1]	3	2	5	0	0	1
7	Cluster Point Beach	6	7	13	0	0	2
8	Skunk Point	37	23	61	0	1	3
TOTAL		**58**	**43**	**103**	**0**	**1**	**7**

Table 28. Snowy Plovers on Santa Rosa Island, 1991 (PRBO, unpubl. data).

[1] Censused for the first time in 1991

SITE #	SITE NAME	MALES	FEMALES	ADULTS UNKNOWN SEX	TOTAL ADULTS	JUVENILES	BROODS	NESTS
1	Soledad Beach	2	2	0	4	0	0	0
2	Arlington Beach	8	2	1	11	0	0	0
3	Sandy Point[1]	ND	ND	ND	ND	ND	ND	ND
4	Mud Tank Beach	4	1	0	5	0	0	1
5	Bee Rock Beach	8	7	0	15	0	2	0
6	Whetstone Beach	4	2	0	6	0	2	2
7	Cluster Point Beach	10	7	2	19	0	0	1
8	Skunk Point	33	18	4	55	0	4	5
TOTAL		**69**	**39**	**7**	**115**	**0**	**8**	**9**

Table 29. Snowy Plovers on Santa Rosa Island, 1992 (PRBO, unpubl. data).

[1] Not surveyed in 1992

FIGURES 1–31

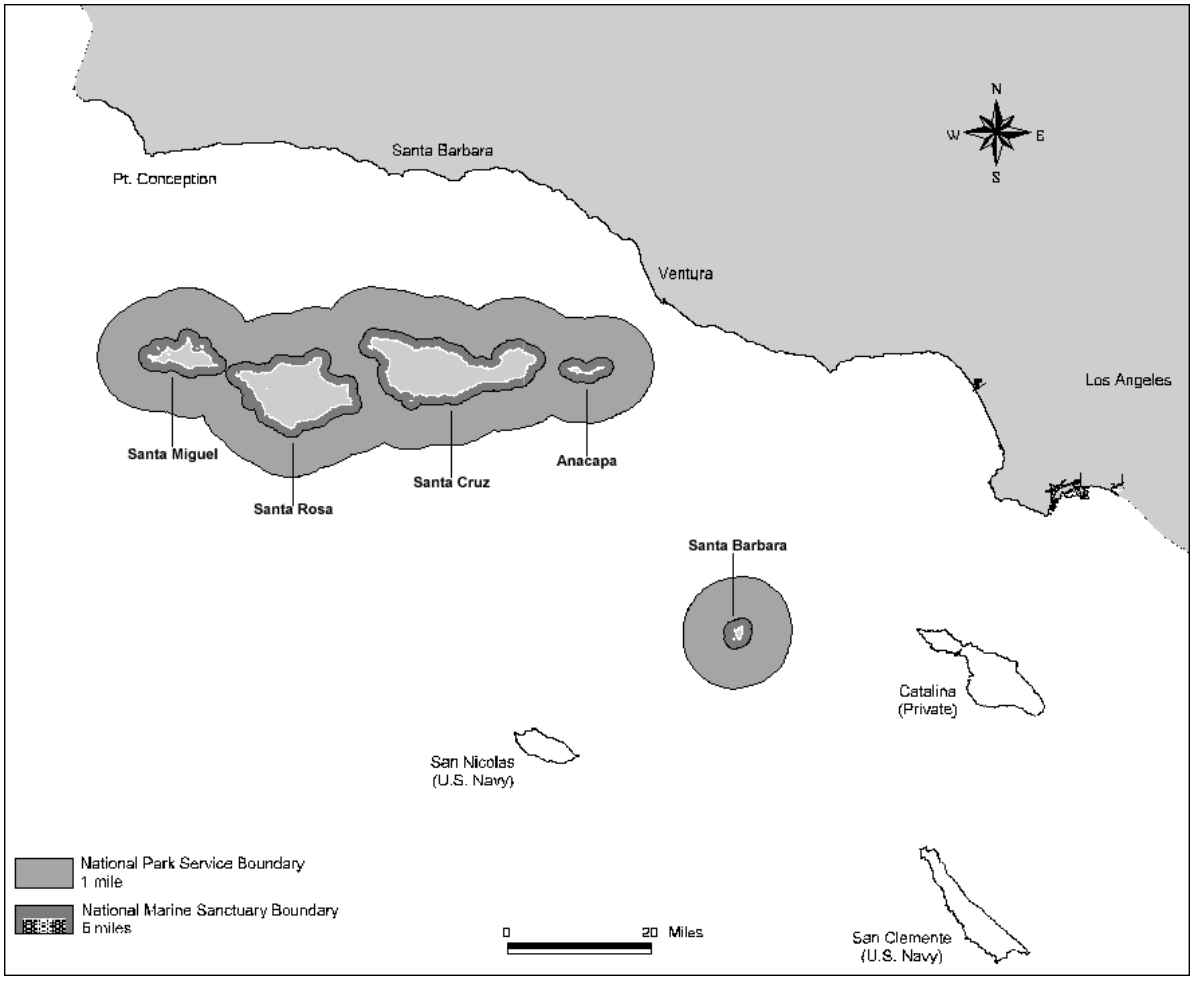


Figure 1. The eight California Channel Islands and adjacent mainland. Channel Islands National Park is comprised of Anacapa, Santa Cruz, Santa Rosa, San Miguel, and Santa Barbara Islands.

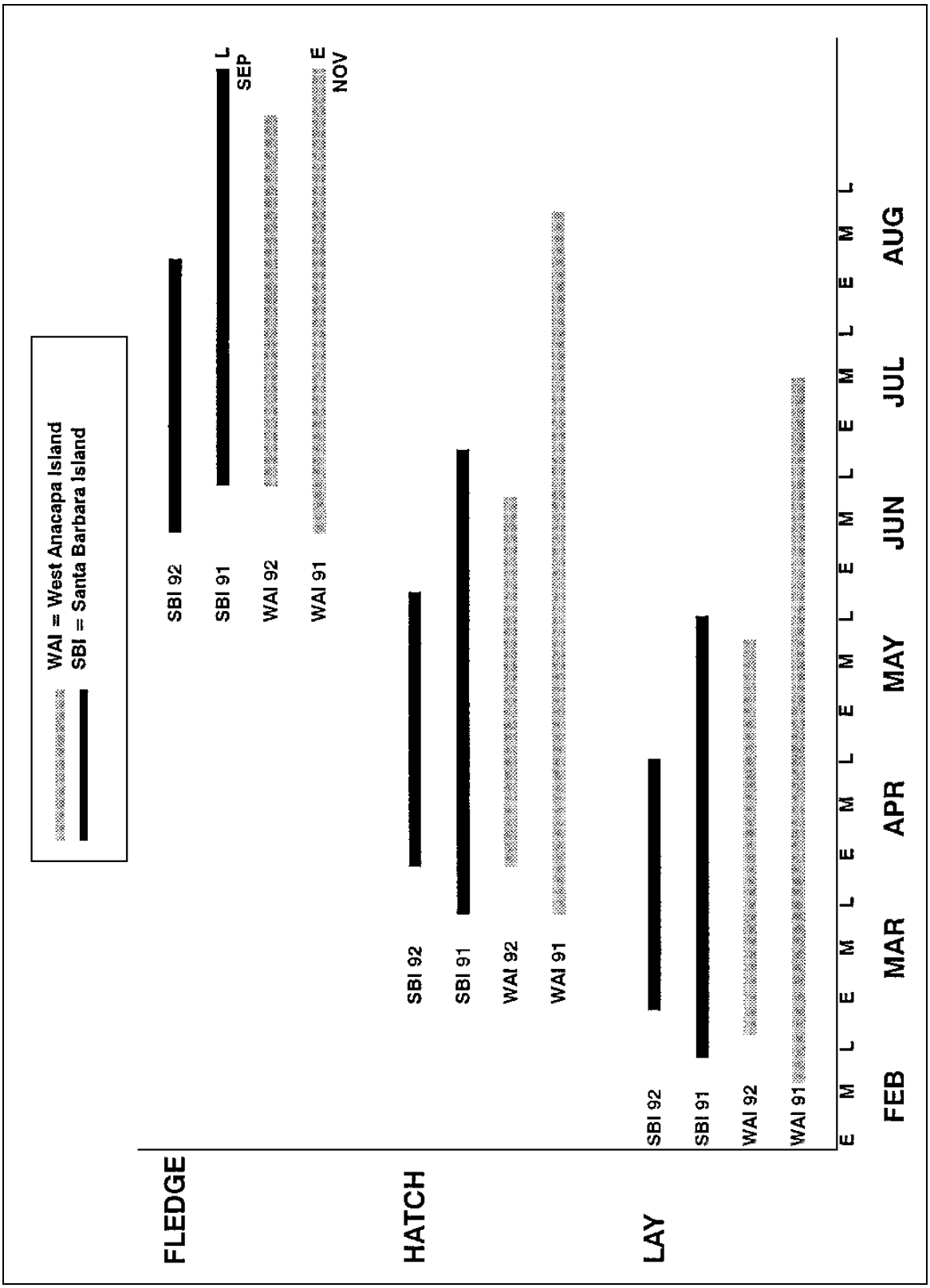


Figure 2. Breeding phenology in Brown Pelicans on West Anacapa and Santa Barbara Islands, 1991–1992 (CHIS Seabird Monitoring Program; F. Gress, unpubl. data).

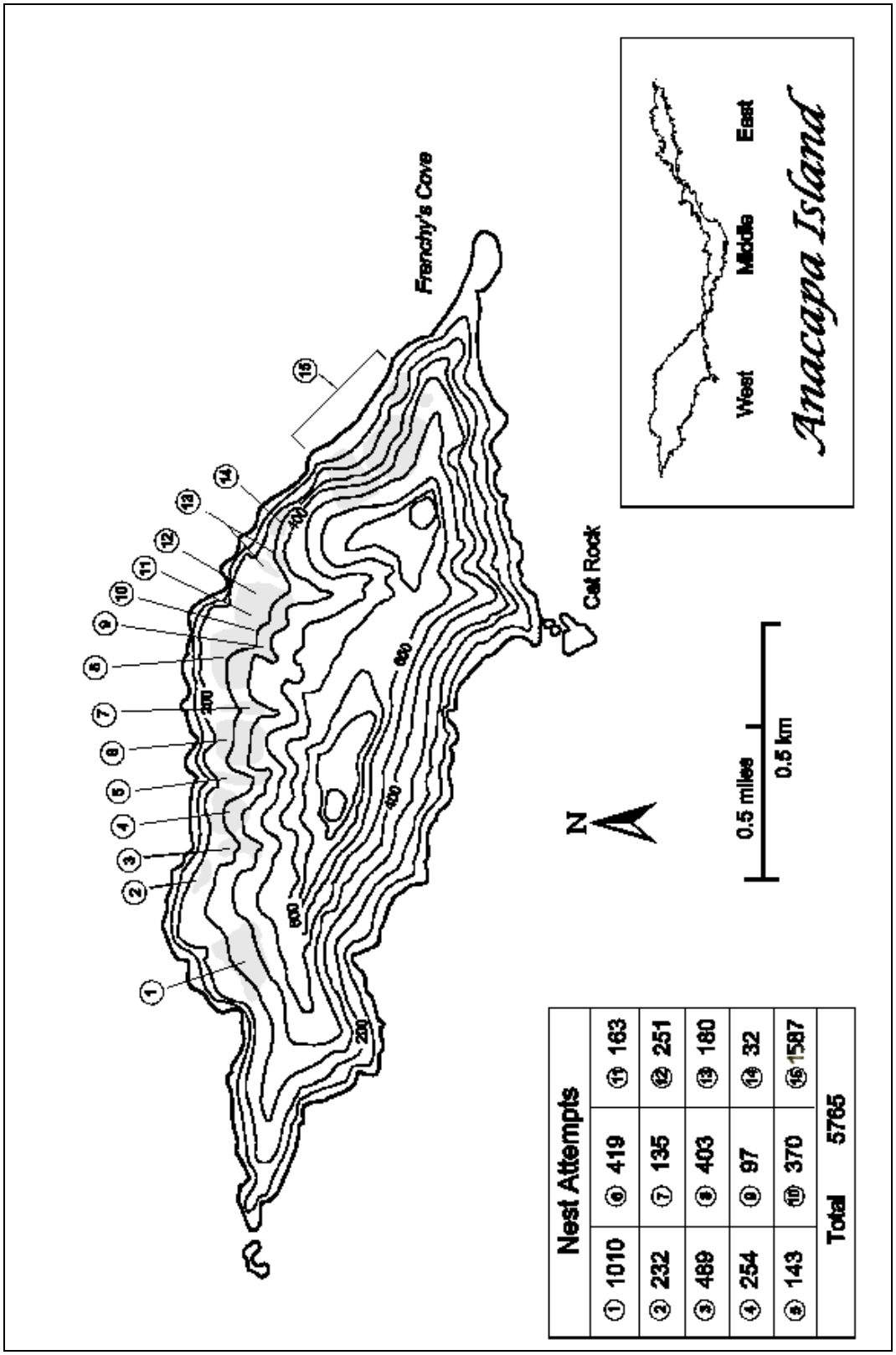


Figure 3. Nesting locations and nest attempts in Brown Pelicans on West Anacapa Island, 1991 (Gress et al. 1993).

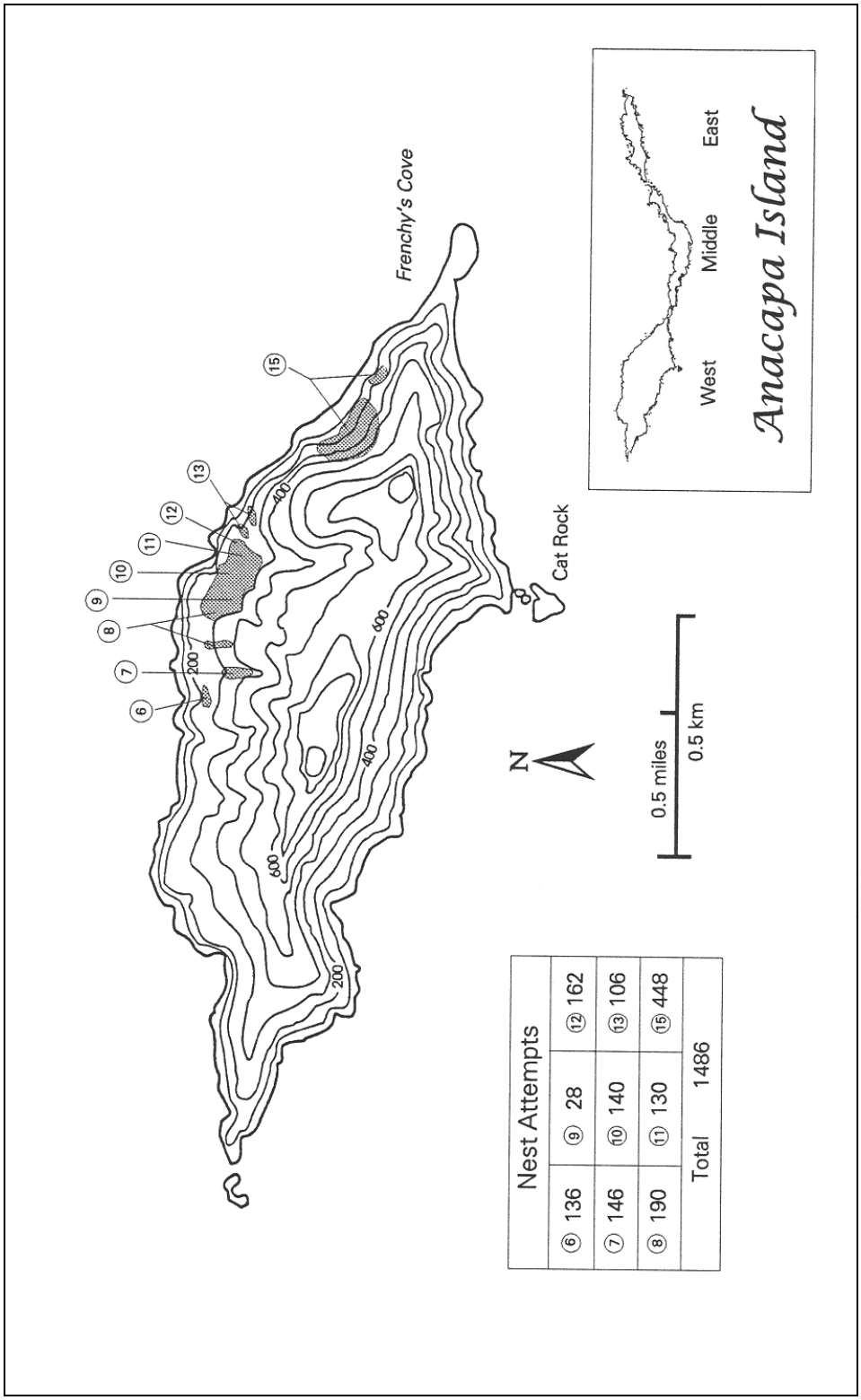
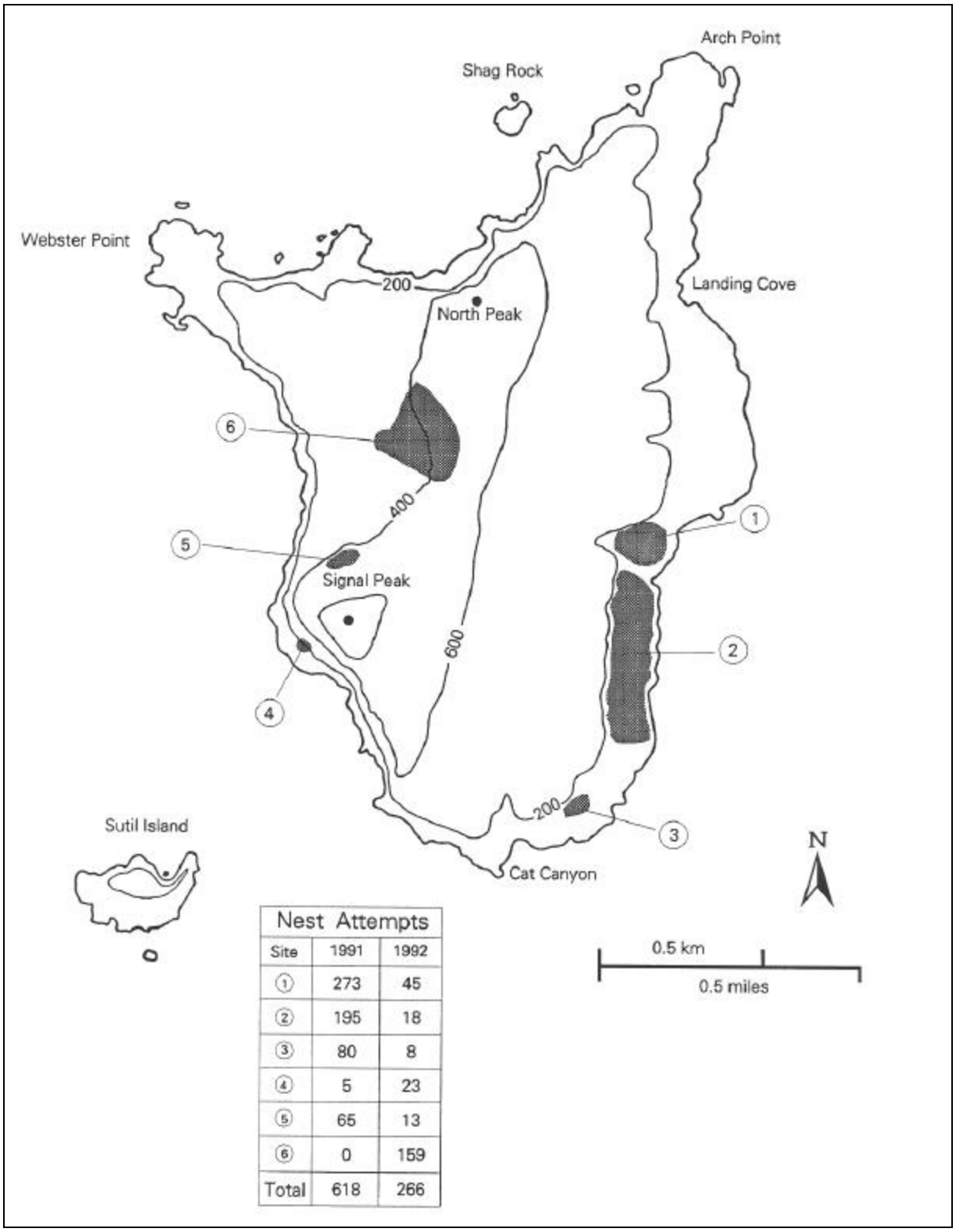


Figure 4. Nesting locations and nest attempts in Brown Pelicans on West Anacapa Island, 1992 (Gress et al. 1993).



Nest Attempts		
Site	1991	1992
①	273	45
②	195	18
③	80	8
④	5	23
⑤	65	13
⑥	0	159
Total	618	266

Figure 5 Nesting locations and nest attempts in Brown Pelicans on Santa Barbara Island, 1991–1992 (CHIS Seabird Monitoring Program; Carter et al. 1992).

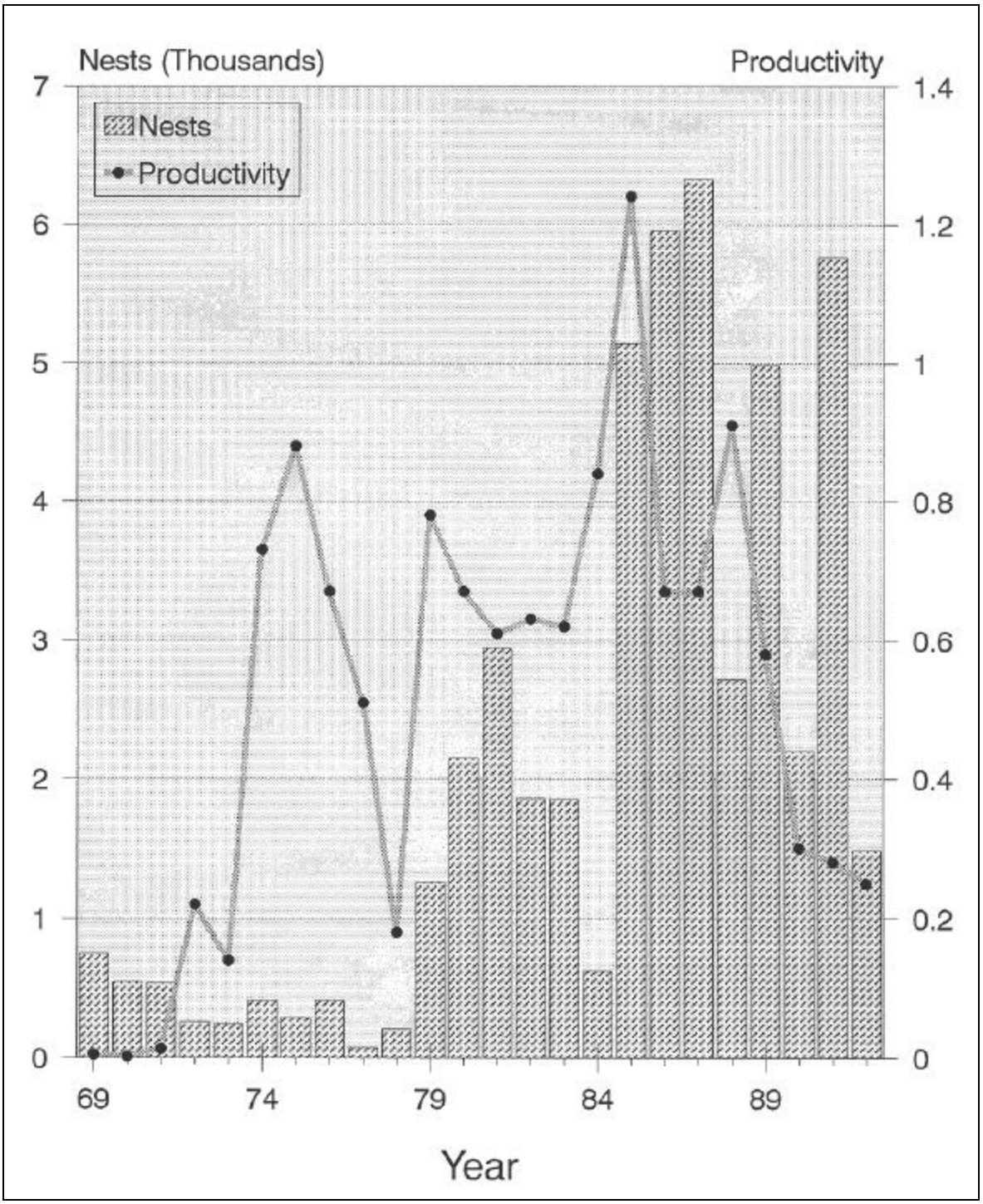


Figure 6. Reproduction in Brown Pelicans on West Anacapa Island, 1969–1992 (See Appendix A for data sources).

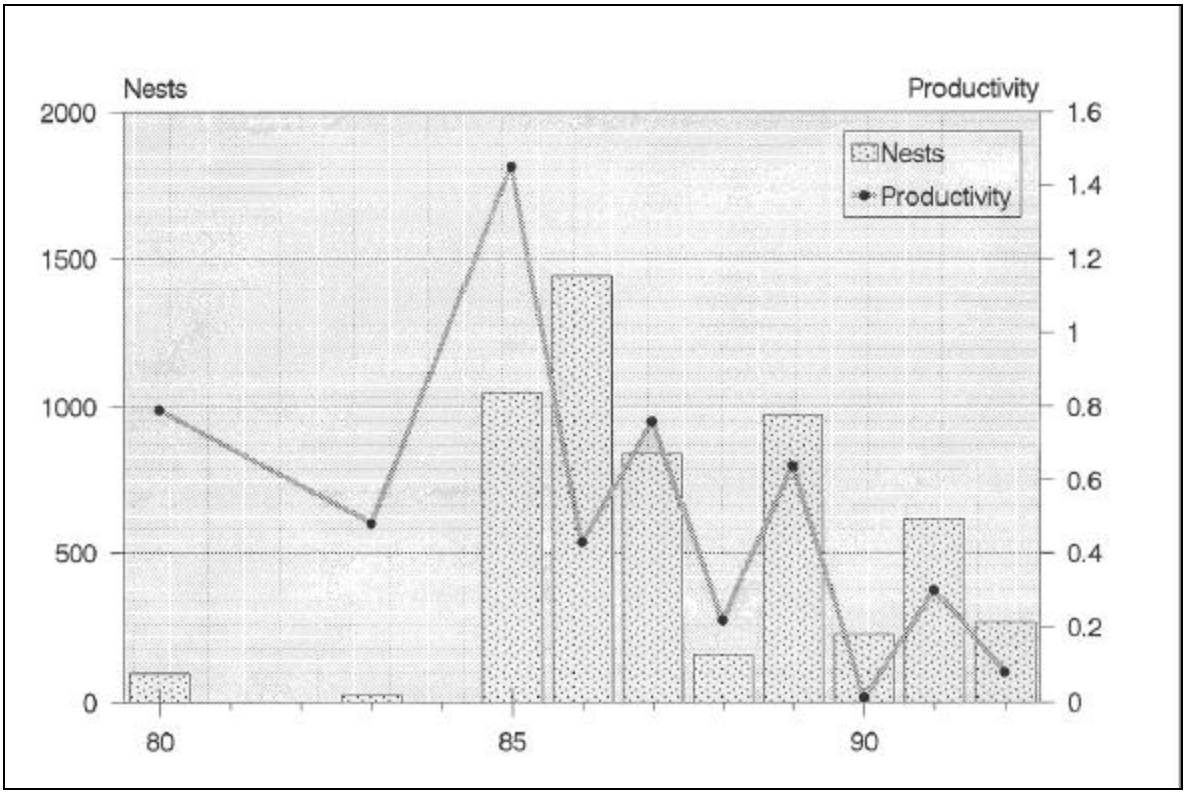


Figure 7. Reproduction in Brown Pelicans on Santa Barbara Island, 1980–1992 (see Appendix A for data sources).

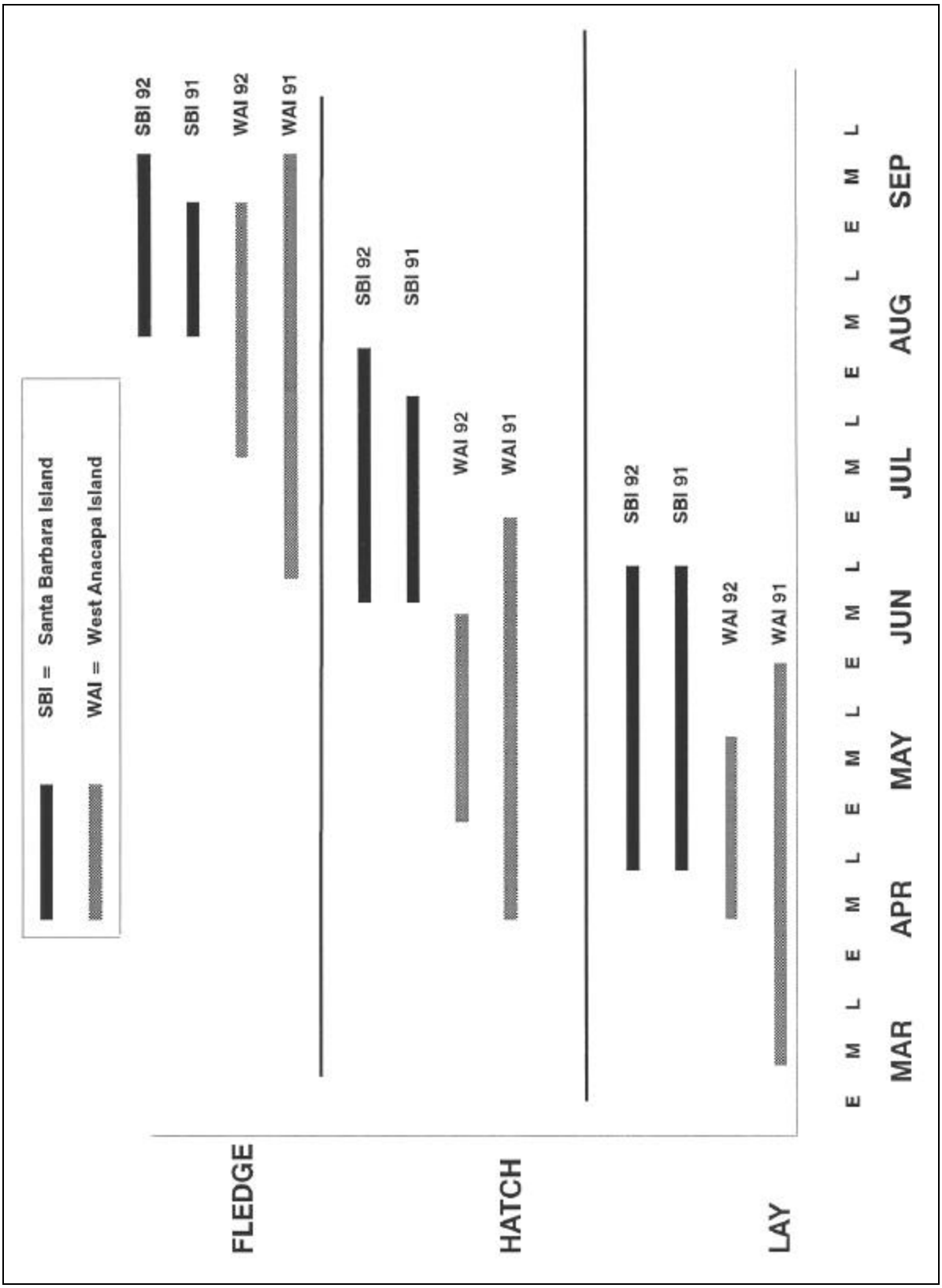
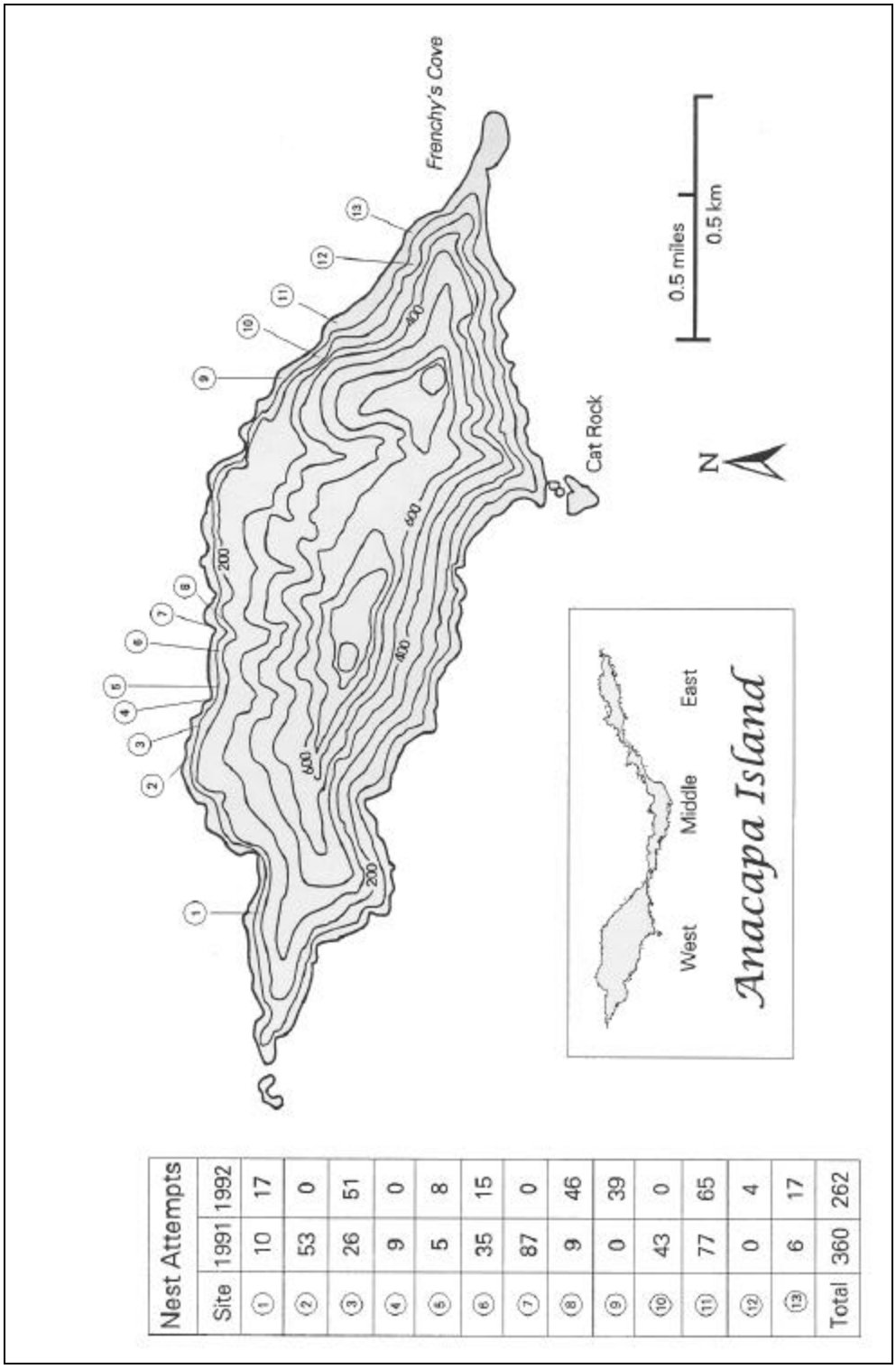


Figure 8. Breeding phenology of Double-Crested Cormorants on West Anacapa and Santa Barbara Islands, 1991–1992 (CHIS Seabird Monitoring Program; F. Gress, unpubl. data).



Nest Attempts		
Site	1991	1992
①	10	17
②	53	0
③	26	51
④	9	0
⑤	5	8
⑥	35	15
⑦	87	0
⑧	9	46
⑨	0	39
⑩	43	0
⑪	77	65
⑫	0	4
⑬	6	17
Total	360	262

Figure 9. Nesting locations and nest attempts in Double-Crested Cormorants on West Anacapa Island, 1991–1992 (F. Gress, unpubl. data).

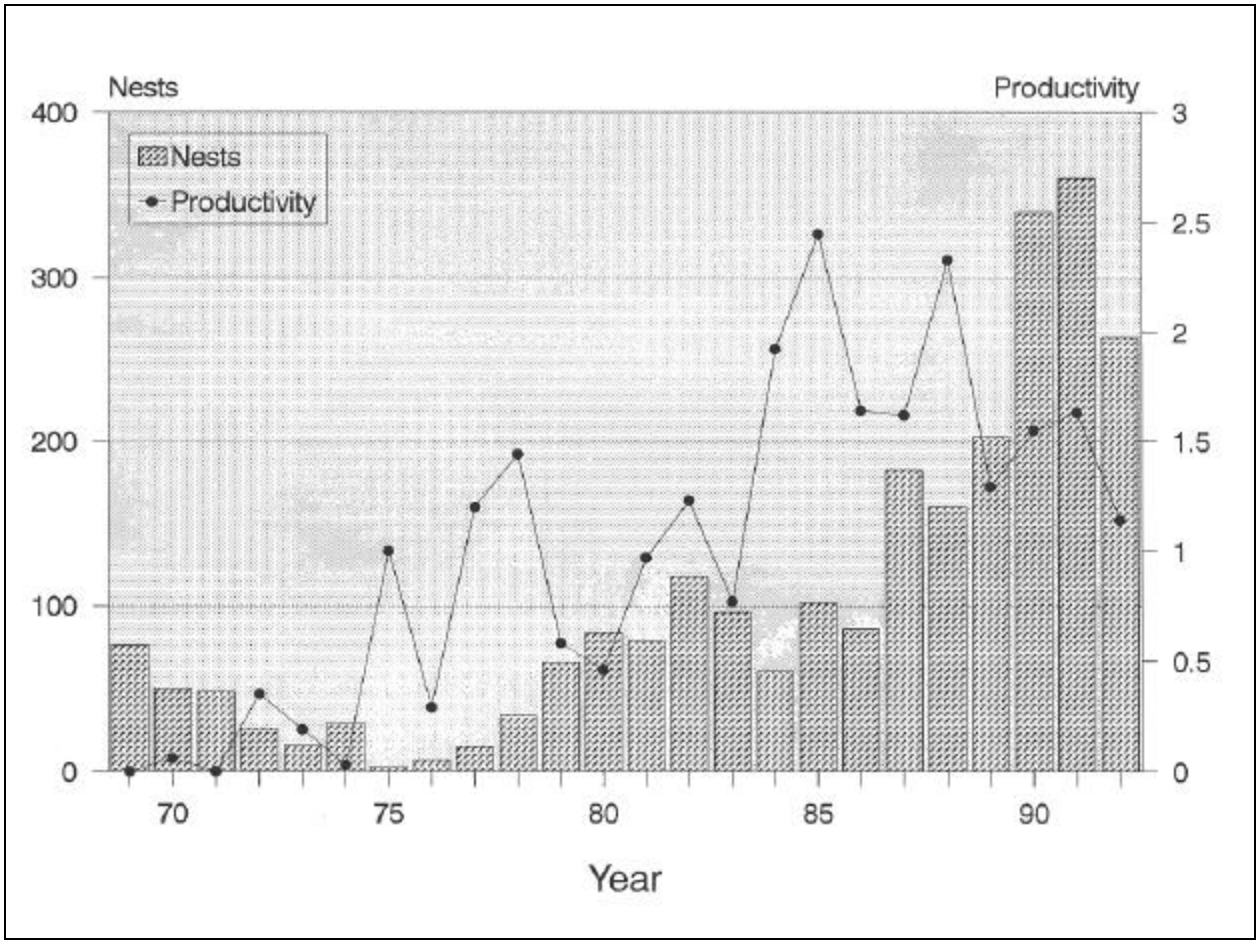
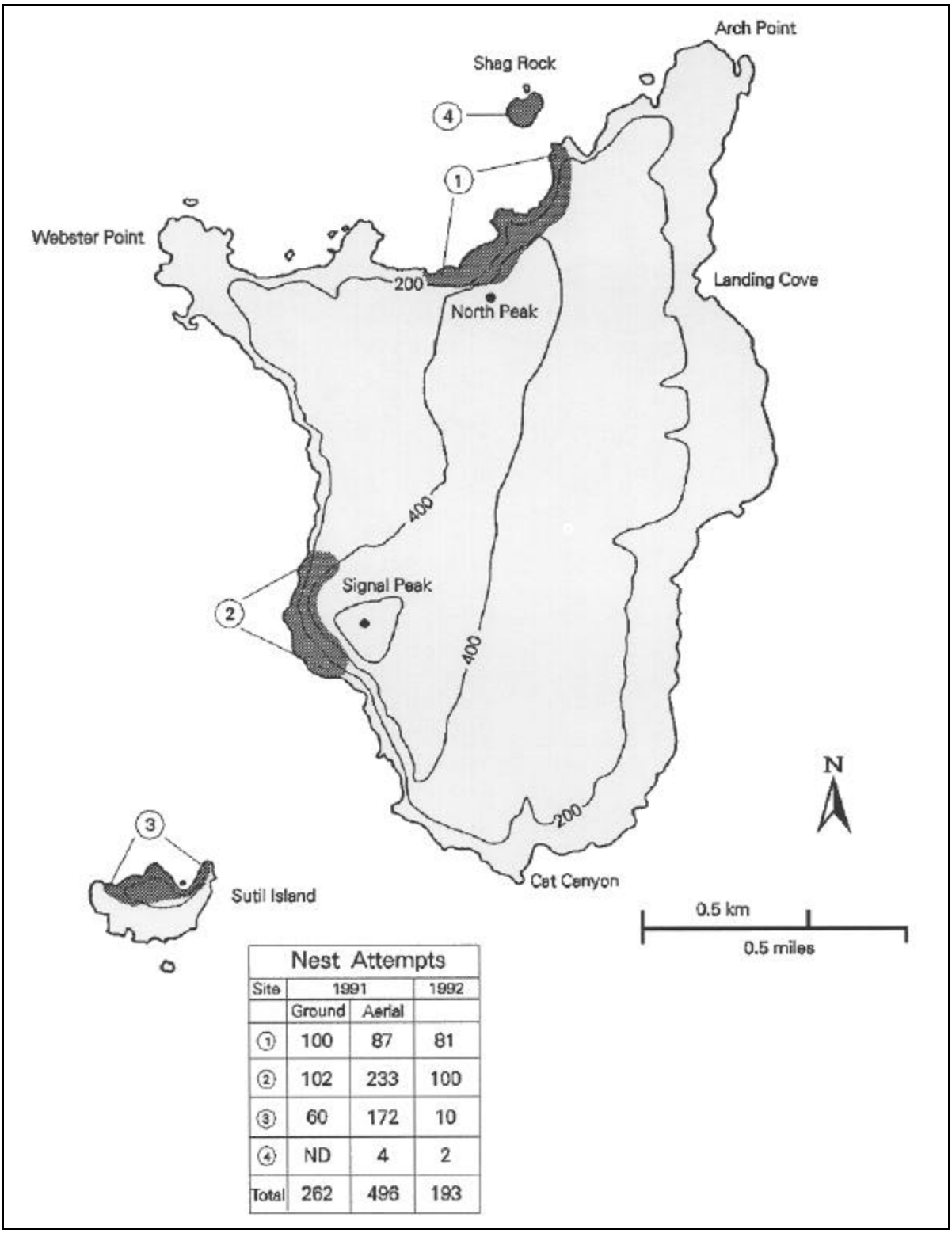


Figure 10. Reproduction in Double-Crested Cormorants on West Anacapa Island, 1969–1992 (see Appendix B for data sources).



Nest Attempts			
Site	1991		1992
	Ground	Aerial	
①	100	87	81
②	102	233	100
③	60	172	10
④	ND	4	2
Total	262	496	193

Figure 11. Nesting locations and nest attempts in Double-Crested Cormorants on Santa Barbara Island, 1991–1992 (CHIS Seabird Monitoring Program; Carter et al. 1992).

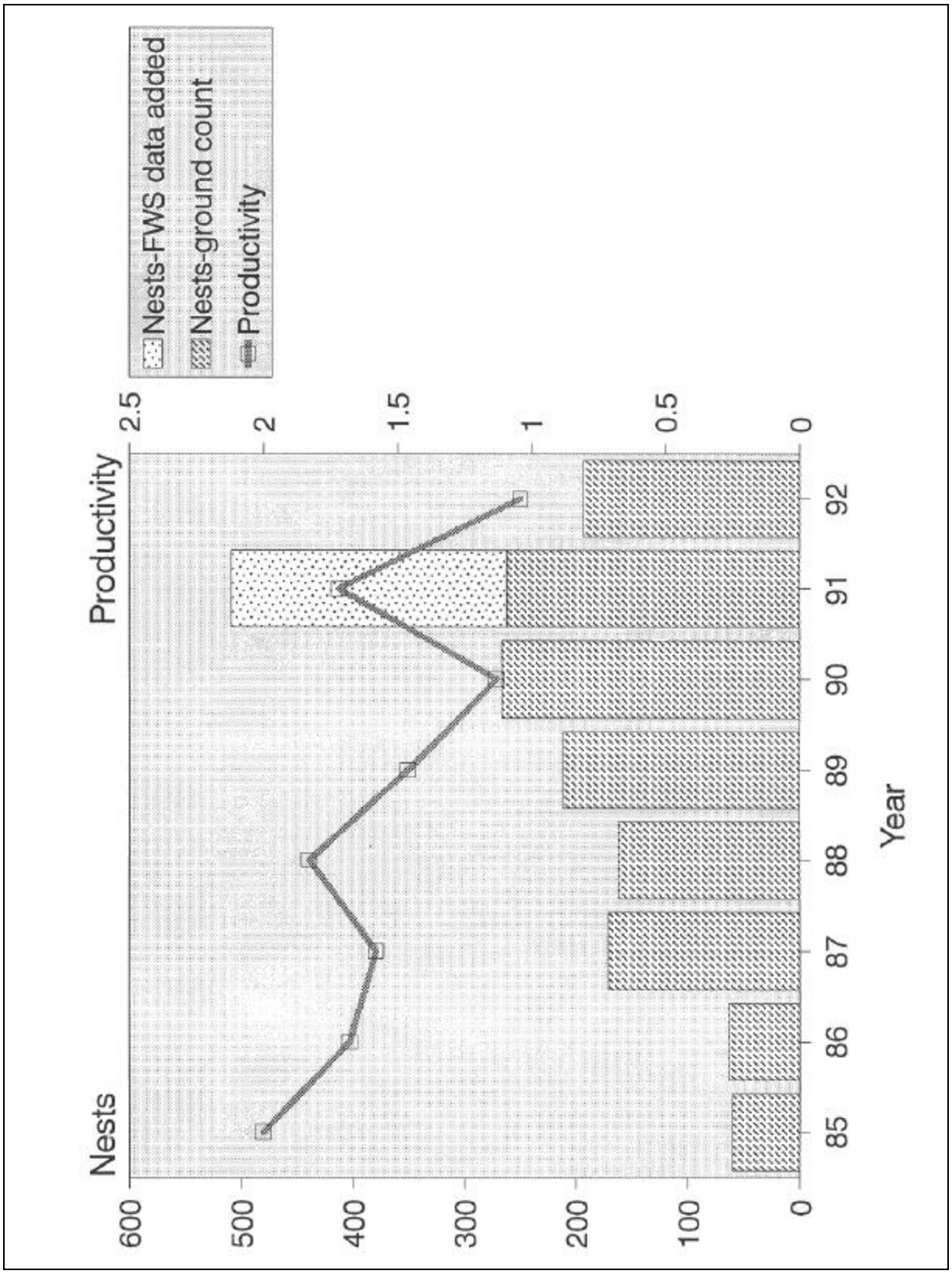
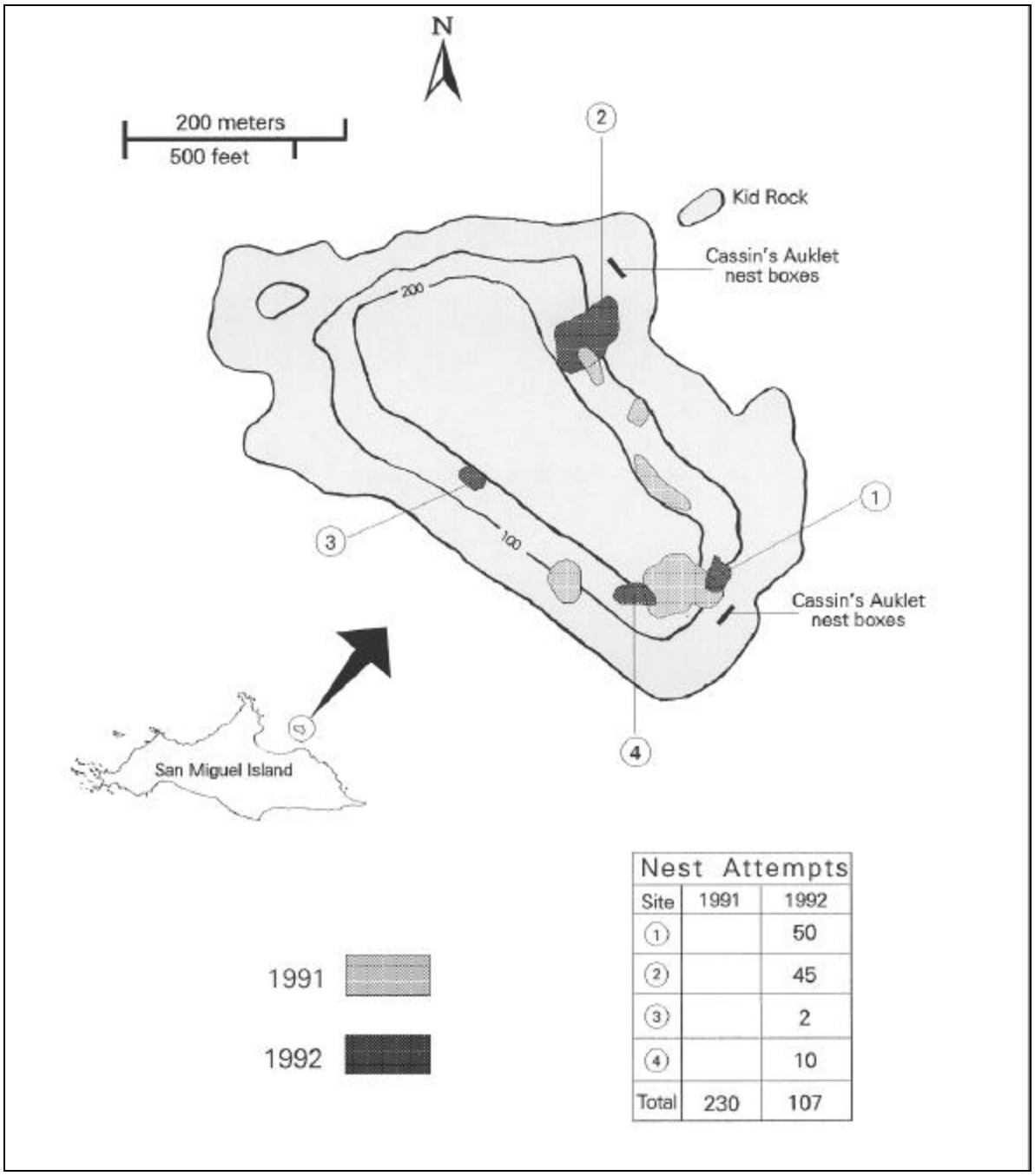


Figure 12. Reproduction in Double-Crested Cormorants on Santa Barbara Island, 1985–1992 (See Appendix B for data sources).



Nest Attempts		
Site	1991	1992
1		50
2		45
3		2
4		10
Total	230	107

Figure 13. Nesting location and nest attempts in Double-Crested Cormorants on Prince Island, 1991–1992 (CHIS Seabird Monitoring Program; Carter et al. 1992).

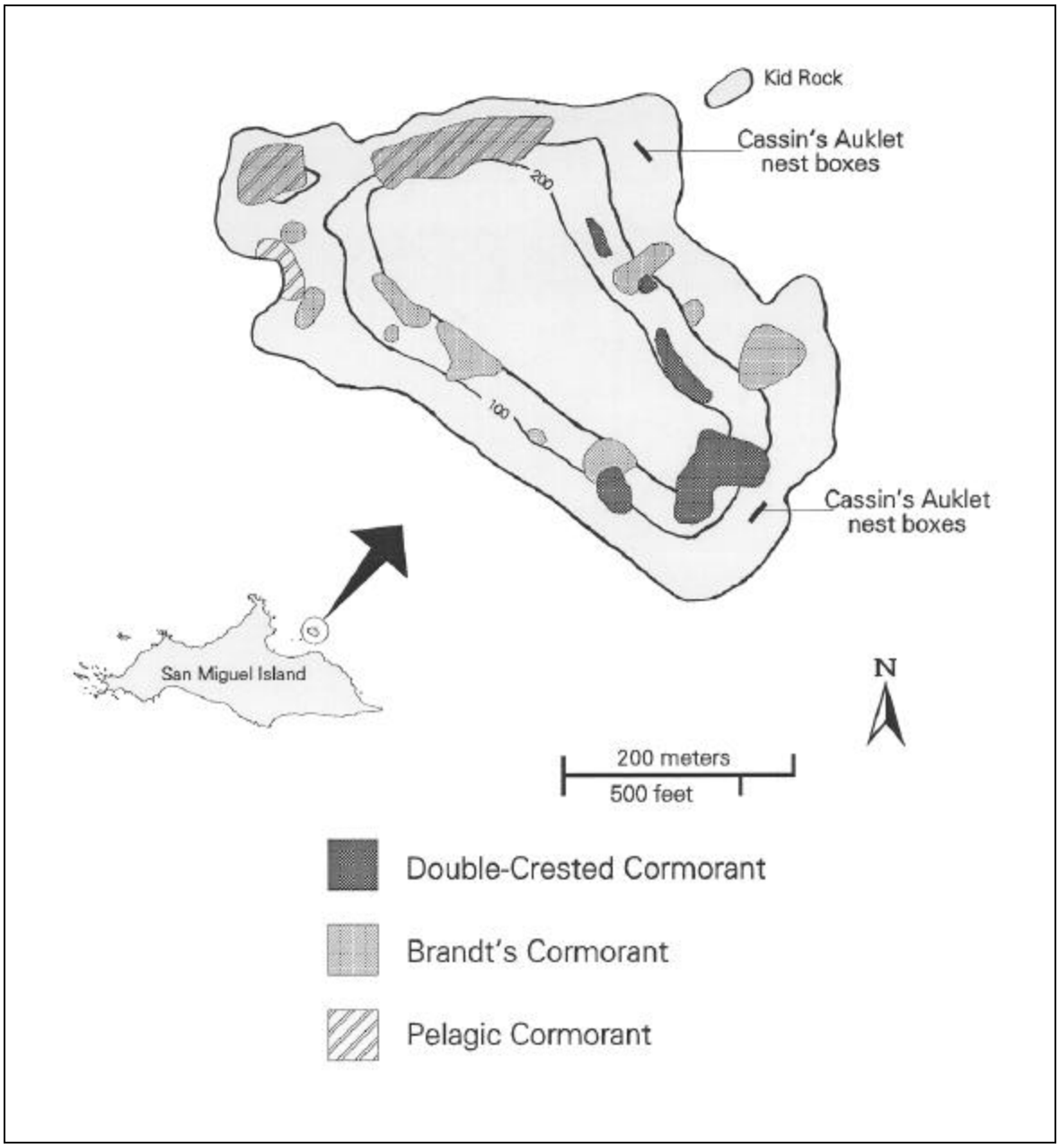


Figure 14. Nesting distribution in Double-Crested, Brandt's, and Pelagic Cormorants on Prince Island, 1991 (Carter et al. 1992; USFWS, unpubl. data).

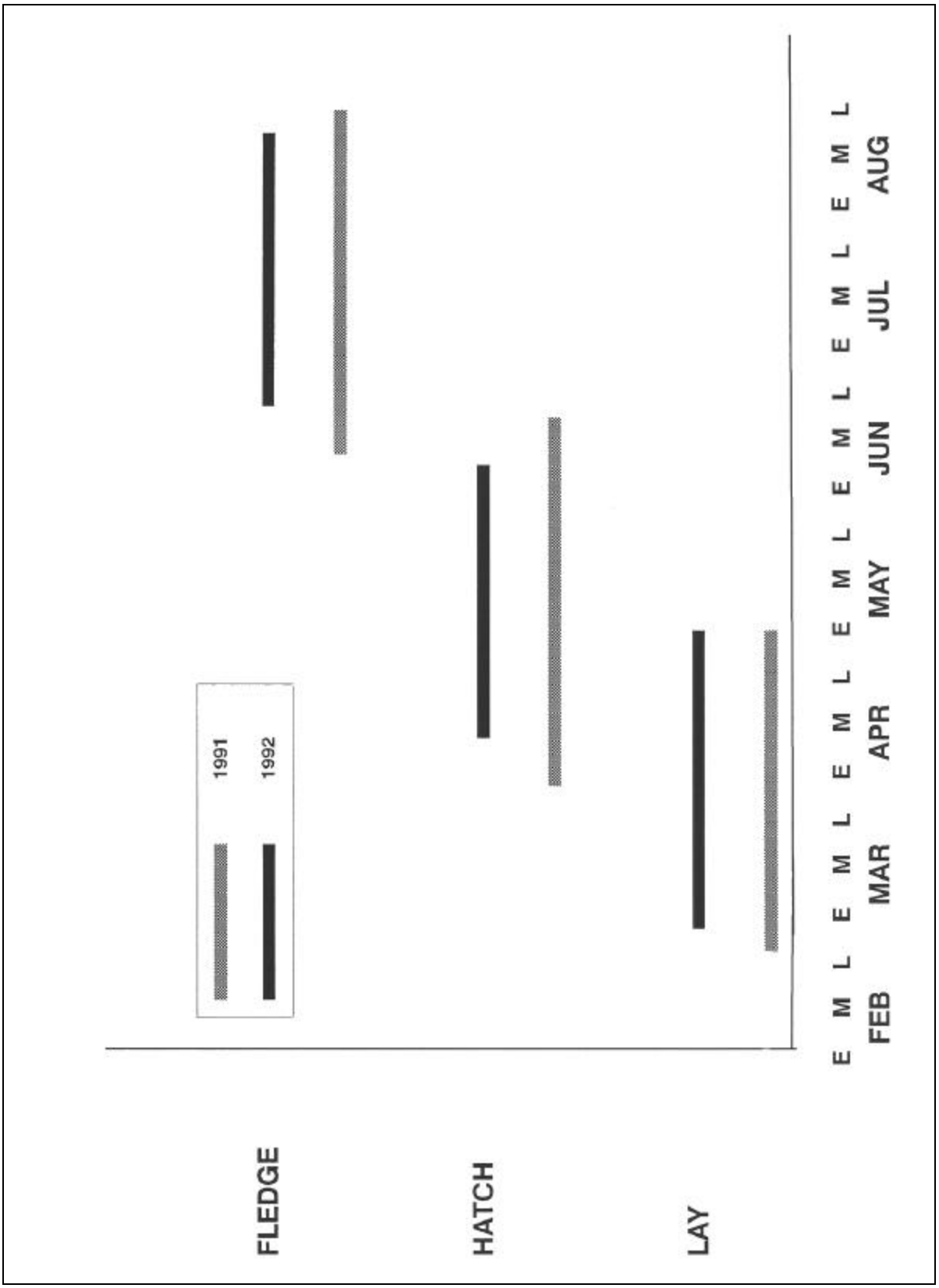


Figure 15. Breeding phenology in Pelagic Cormorants on Anacapa Island, 1991–1992 (F. Gress, unpubl. data).

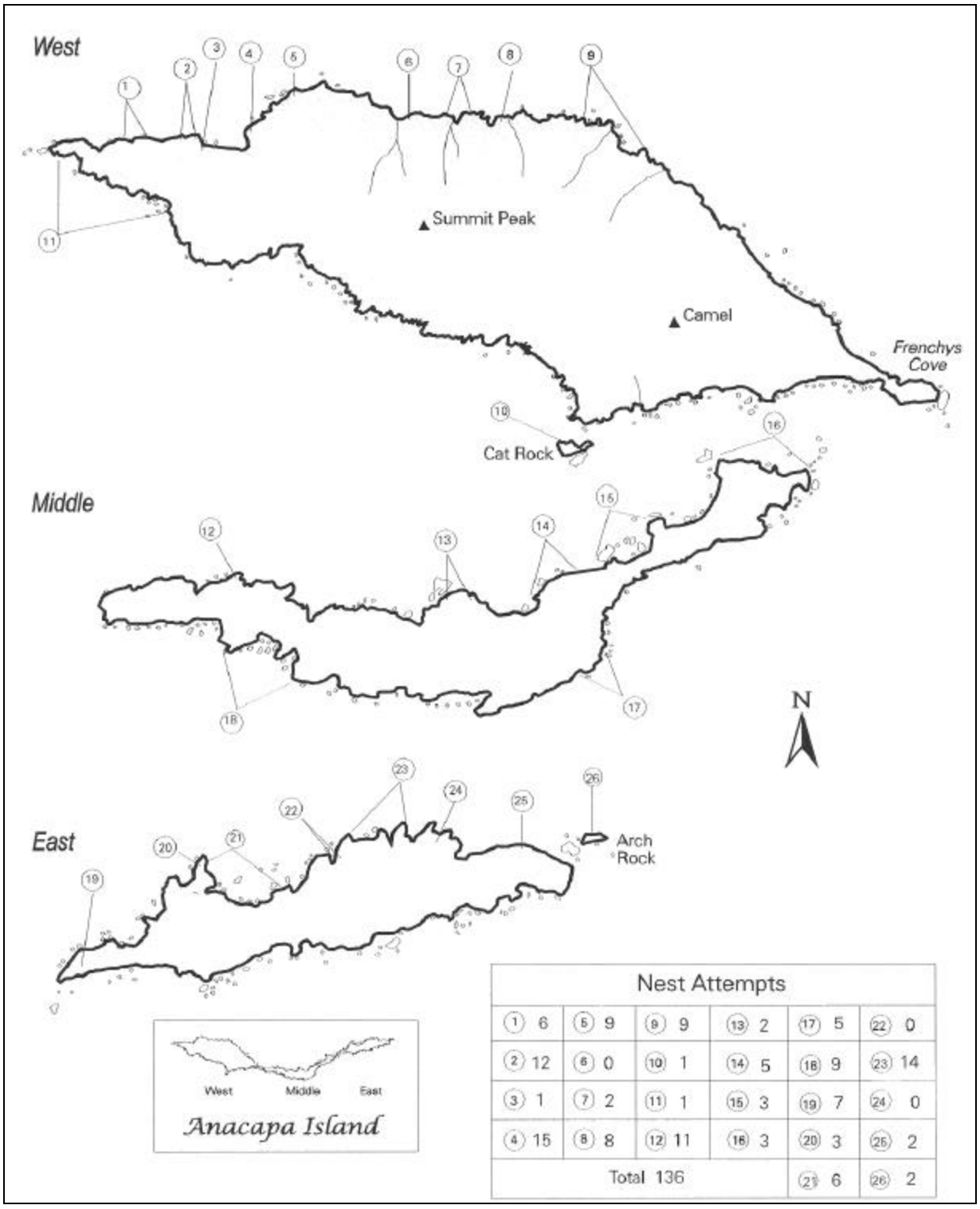


Figure 16. Nesting locations and nest attempts in Pelagic Cormorants on Anacapa Island, 1991 (Carter et al. 1992; F. Gress, unpubl. data). See text for data treatment.

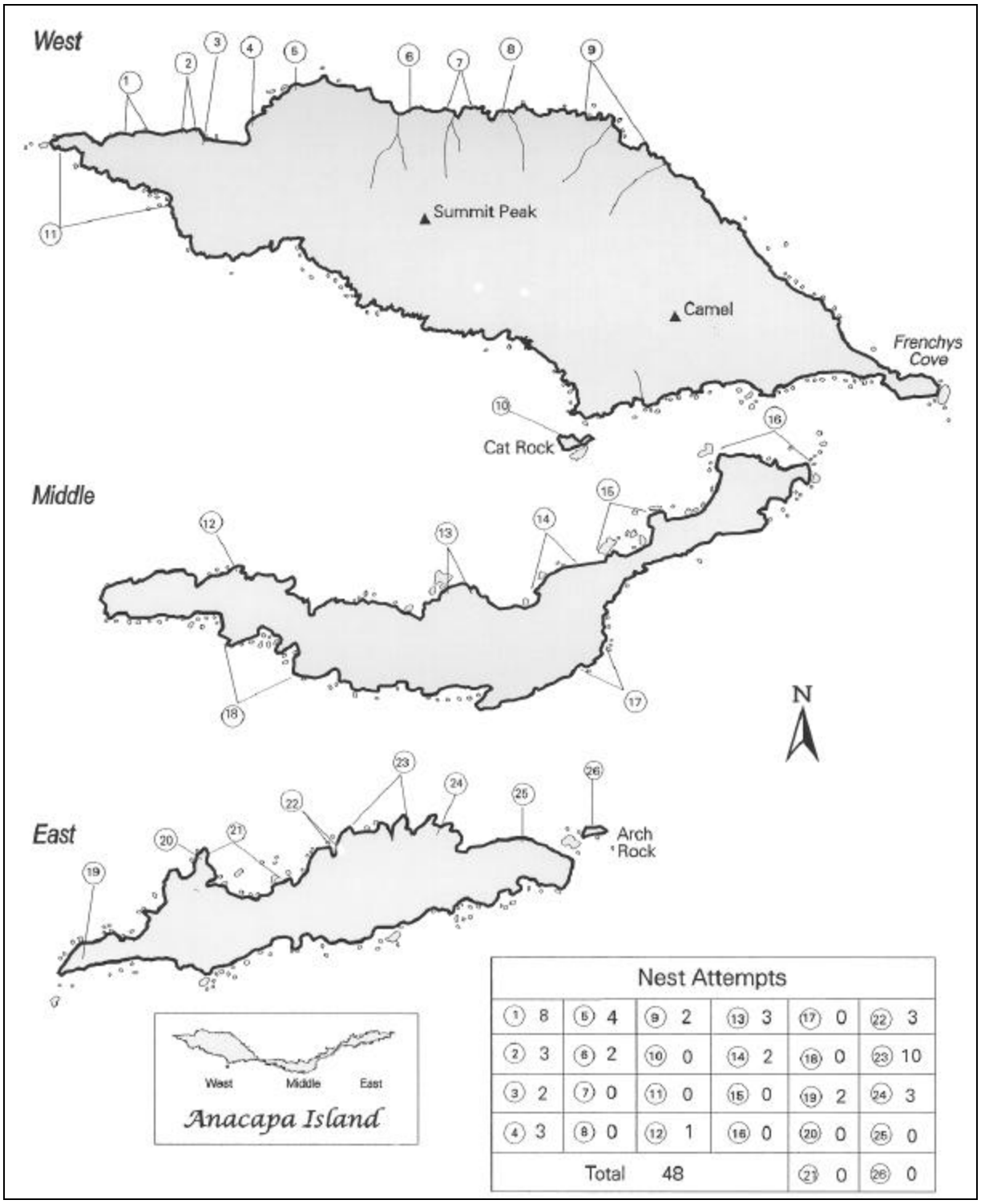


Figure 17. Nesting locations and nest attempts in Pelagic Cormorants on Anacapa Island, 1992 (F. Gress, unpubl. data).

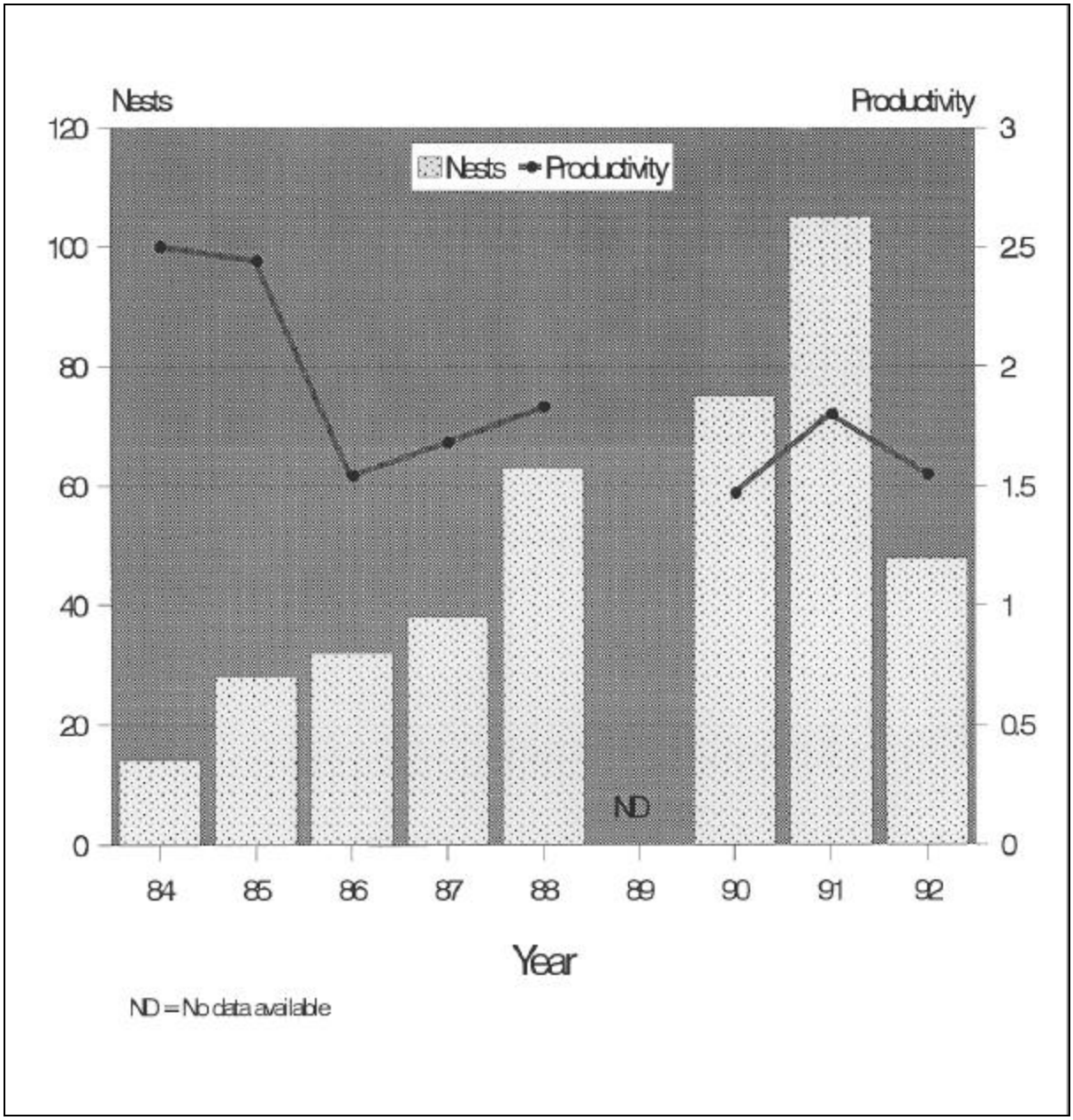


Figure 18. Reproduction in Pelagic Cormorants on Anacapa Island, 1984–1992. Data for 1984–1985, 1987–1988, 1990, 1992 (F. Gress, unpubl.); 1986 (Lewis and Gress, 1988); 1989 (NPS, unpubl. data); 1991 (Carter et al. 1992; F. Gress, unpubl. data).

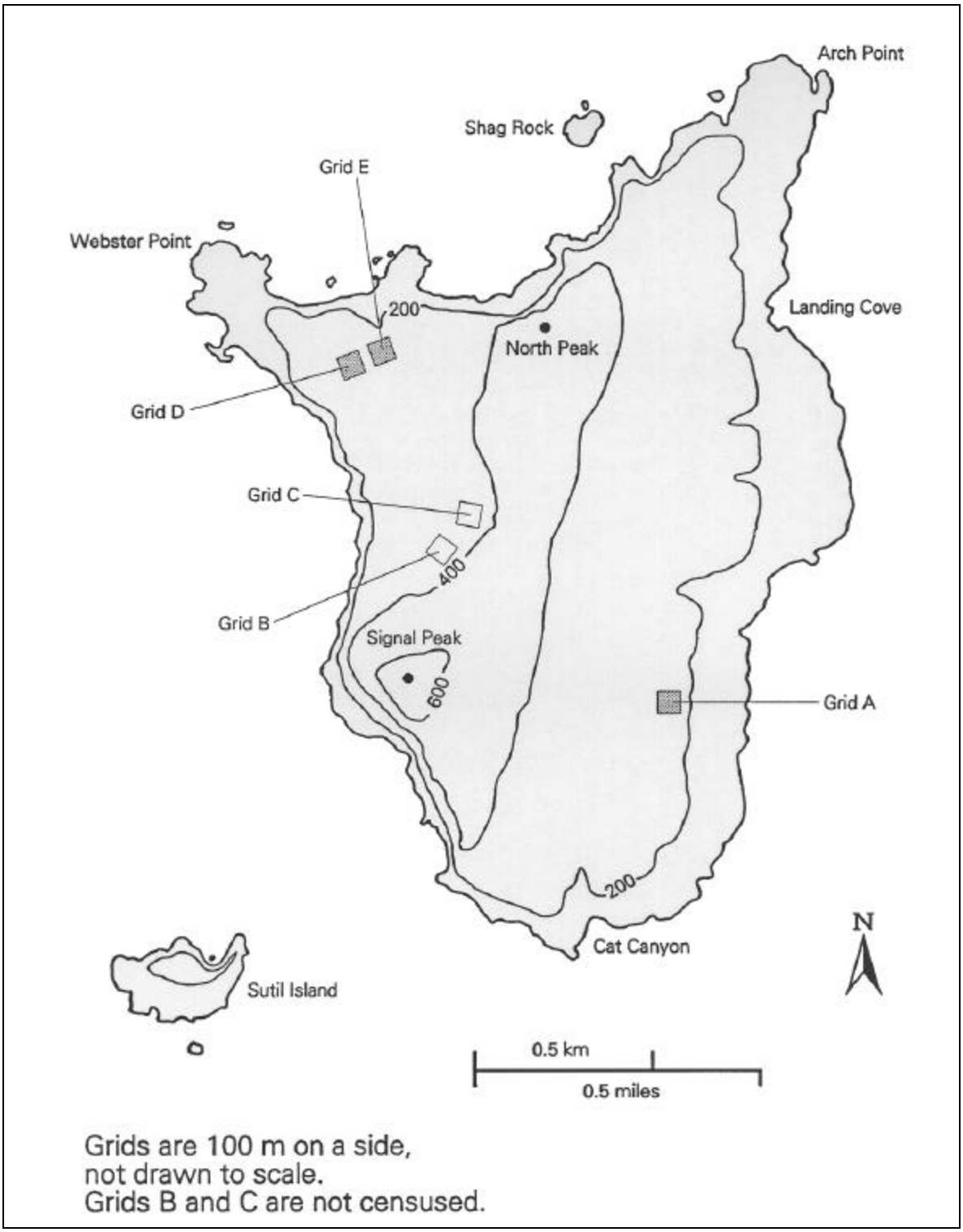


Figure 19. Western Gull sample grid locations on Santa Barbara Island (CHIS Seabird Monitoring Program).

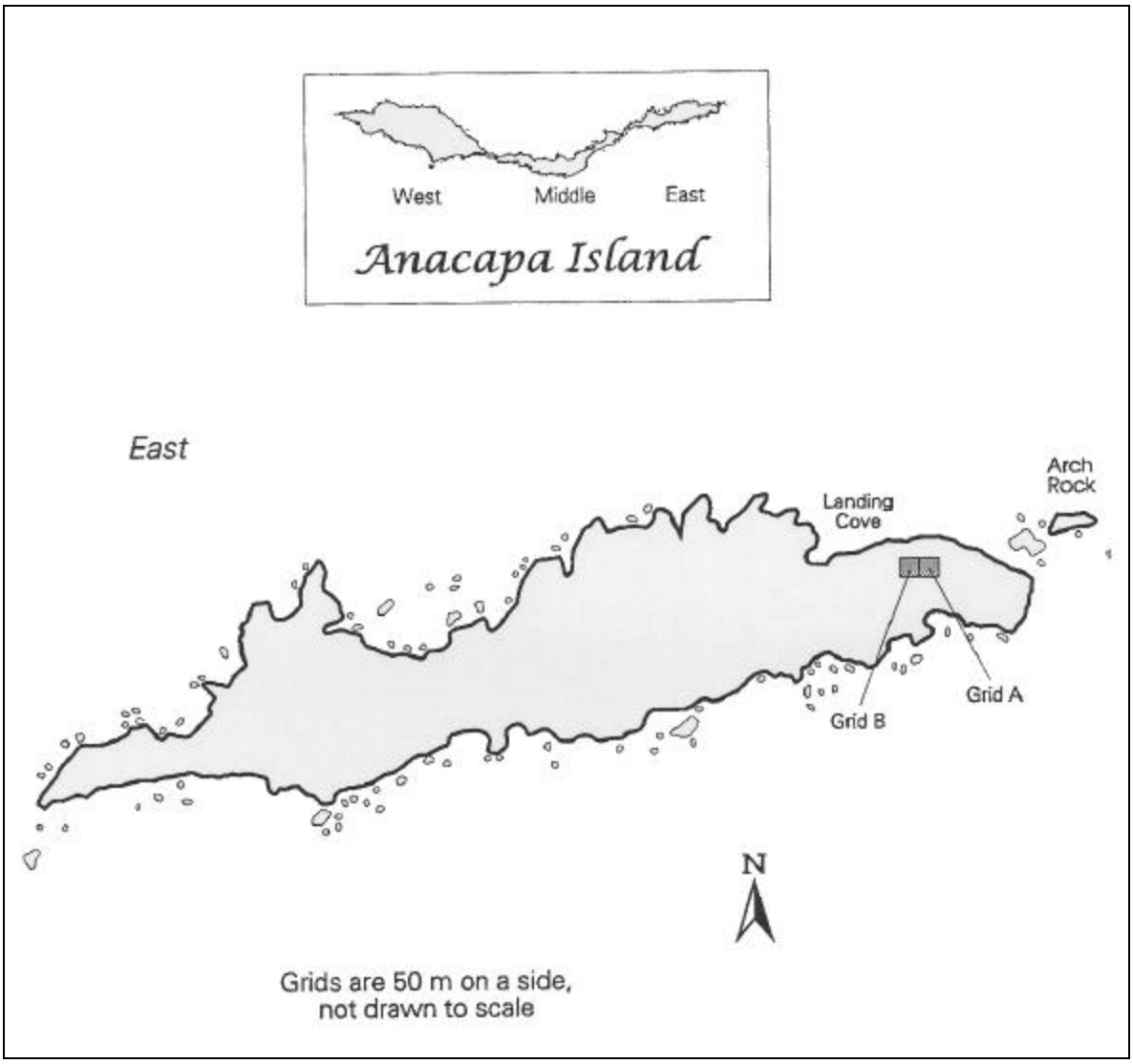


Figure 20. Western Gull sample grid locations on East Anacapa Island (CHIS Seabird Monitoring Program.

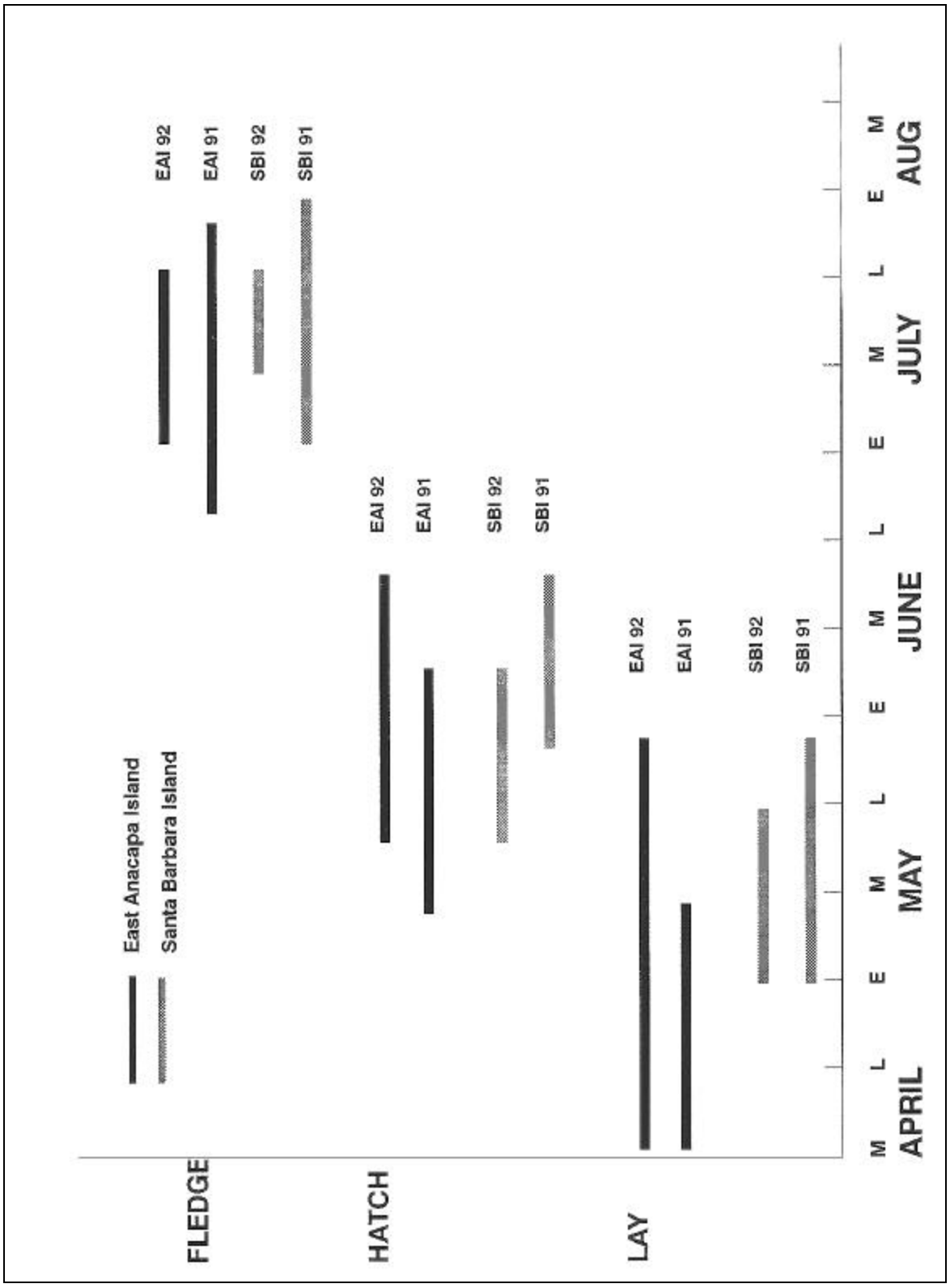


Figure 21. Breeding phenology in Western Gulls on Santa Barbara and East Anacapa Islands, 1991–1992 (CHIS Seabird Monitoring Program).

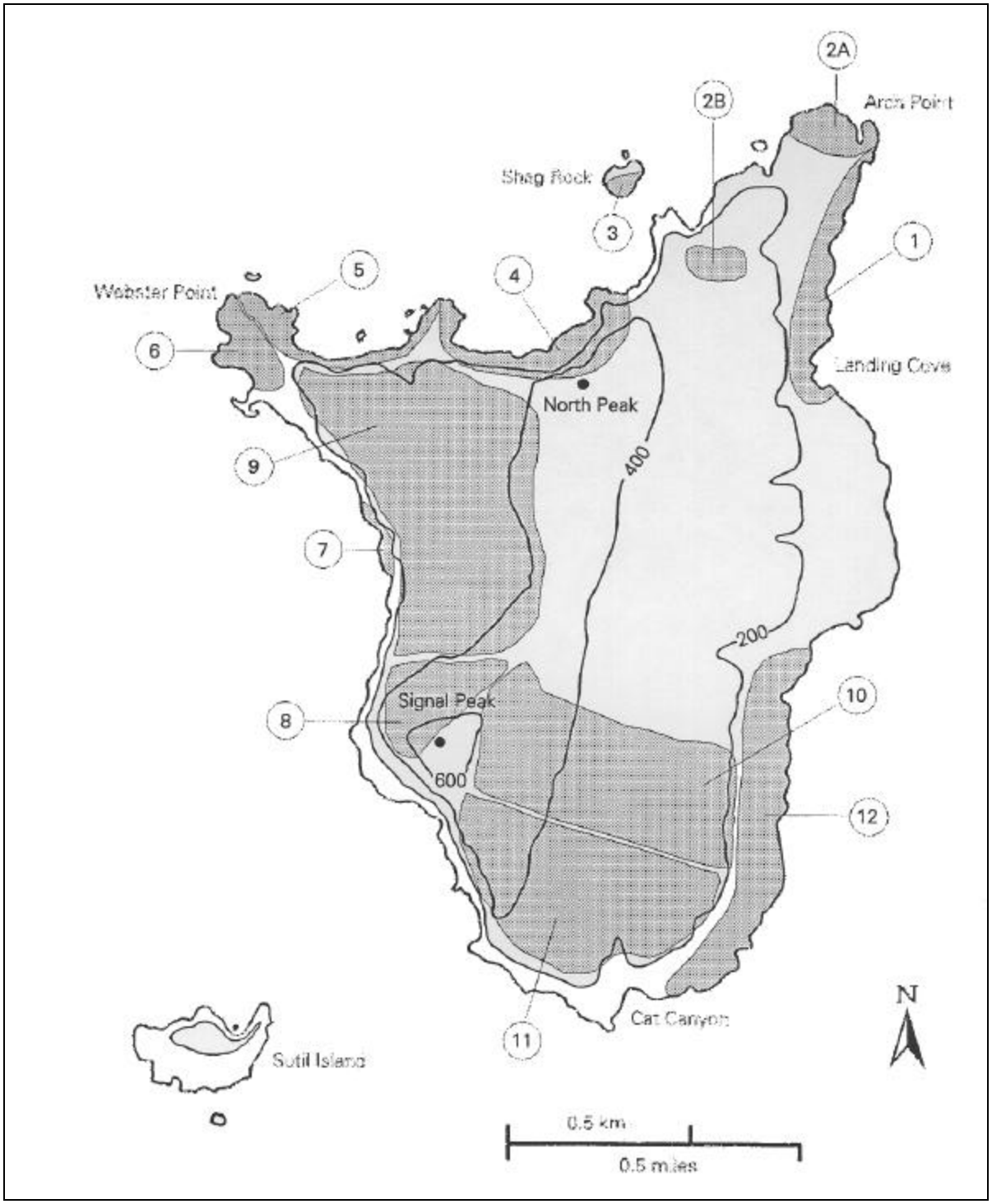


Figure 22. Census areas for Western Gull total nest count on Santa Barbara Island (CHIS Seabird Monitoring Program; Carter et al. 1992).

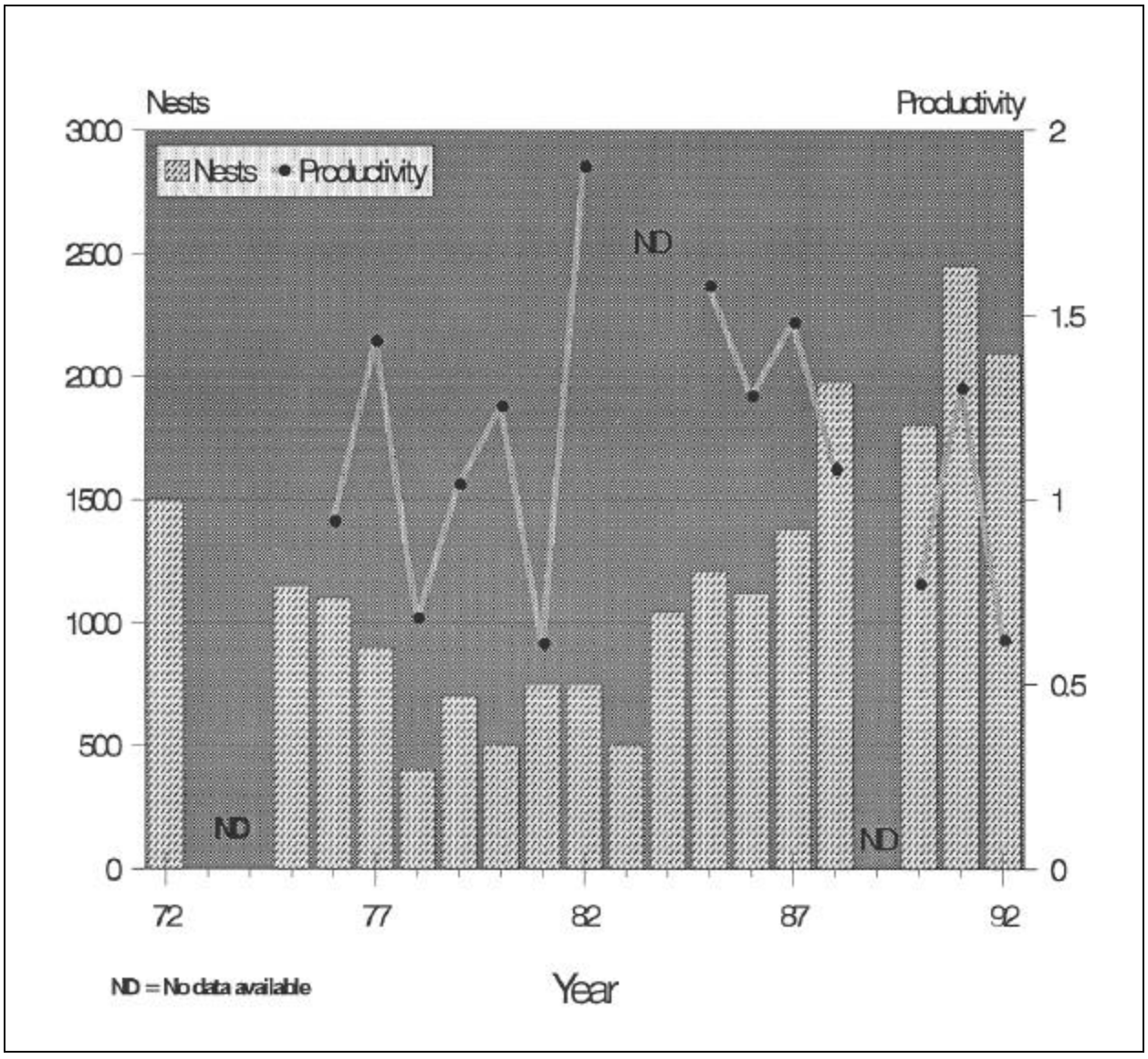
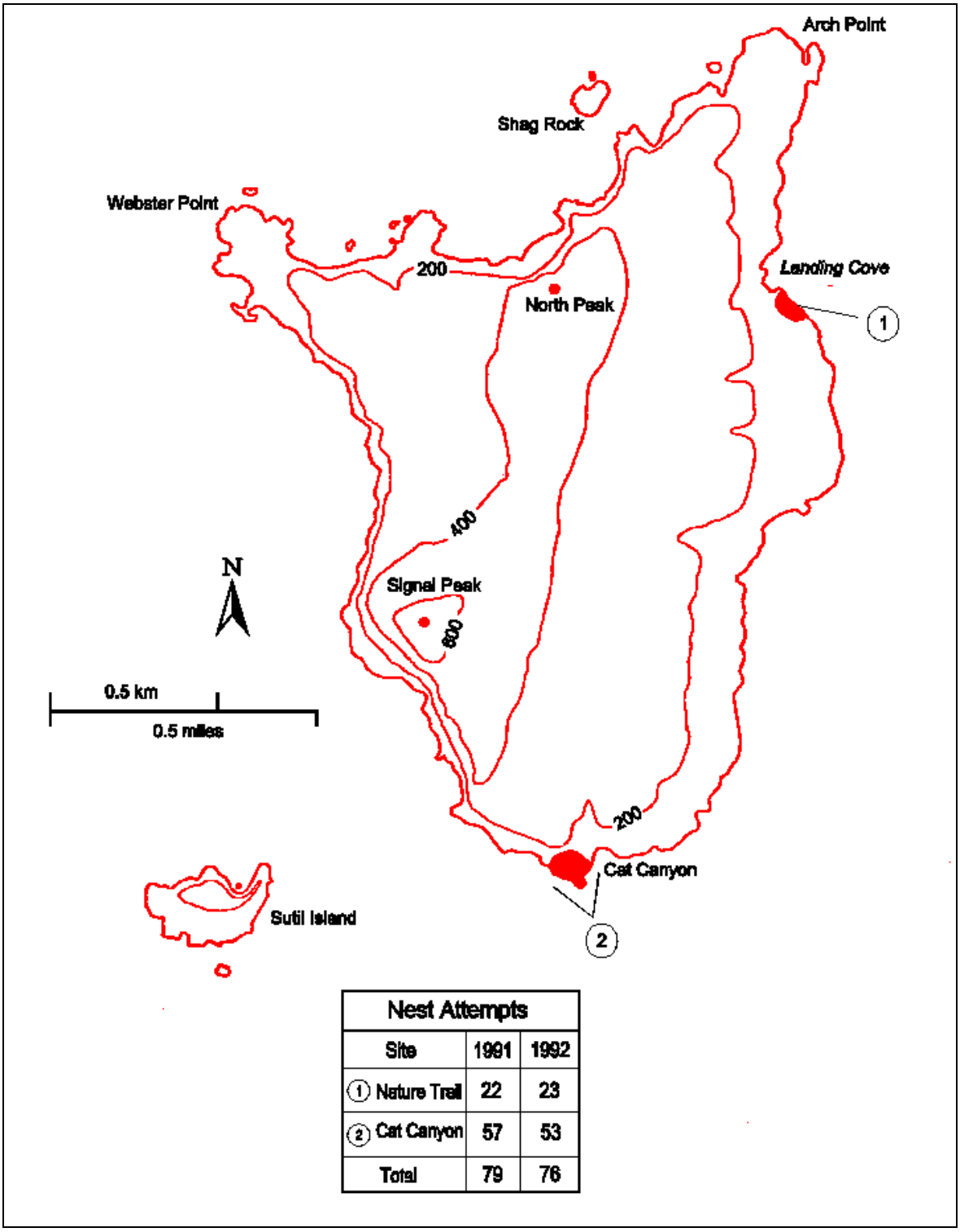


Figure 23. Reproduction in Western Gulls on Santa Barbara Island, 1972–1992. Data for 1972–1984 (G. L. Hunt, Jr., unpubl. data); 1985 (Lewis and Gress, unpubl. ms); 1986 (Lewis and Gress 1988); 1987–1989 (NPS, unpubl. data); 1990 (Ingram 1992); 1991–1992 (this report).



Nest Attempts		
Site	1991	1992
(1) Nature Trail	22	23
(2) Cat Canyon	57	53
Total	79	76

Figure 24. Study areas and nest attempts in Xantus' Murrelets at Nature Trail and Cat Canyon, Santa Barbara Island, 1991–1992 (CHIS Seabird Monitoring Program). See Carter et al. (1992) for complete description of nesting area locations.

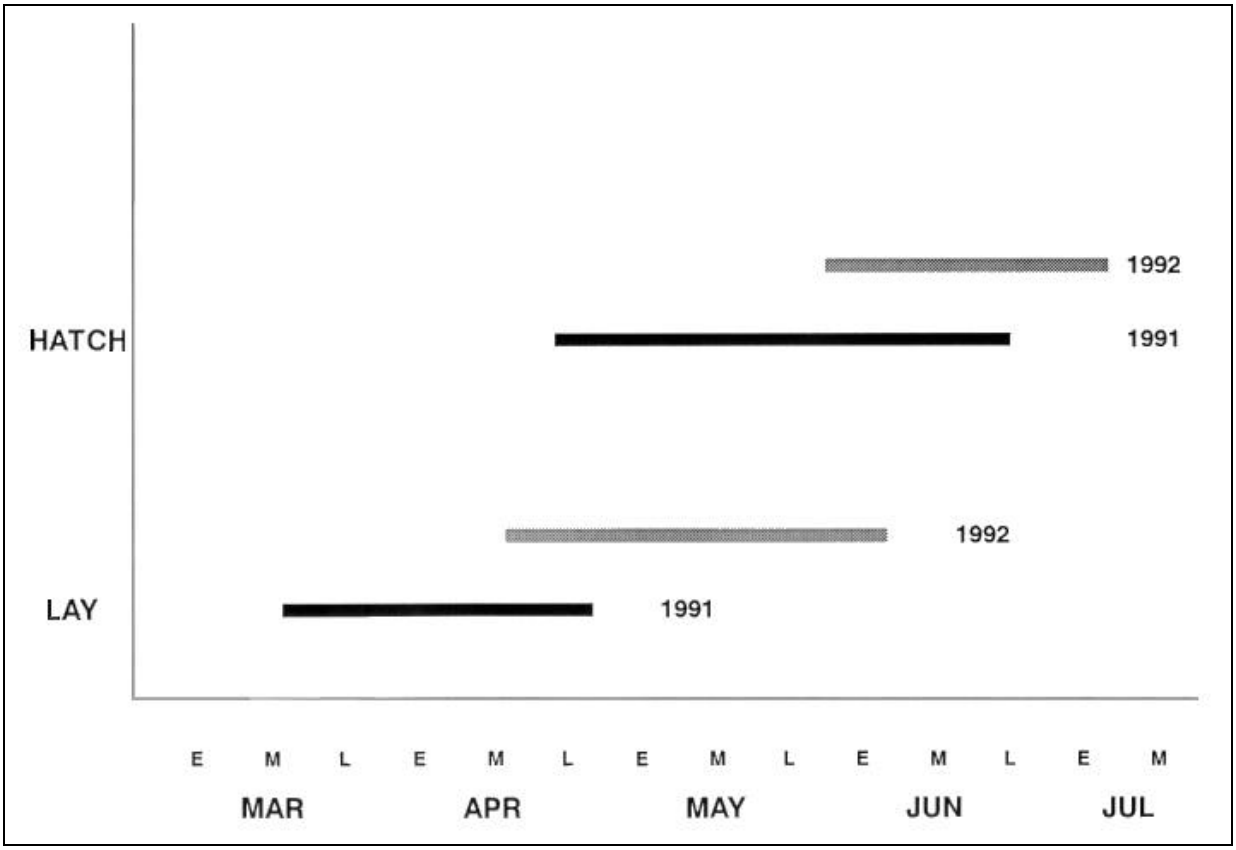


Figure 25. Breeding phenology in Xantus' Murrelets on Santa Barbara Island, 1992–1992 (CHIS Seabird Monitoring Program.

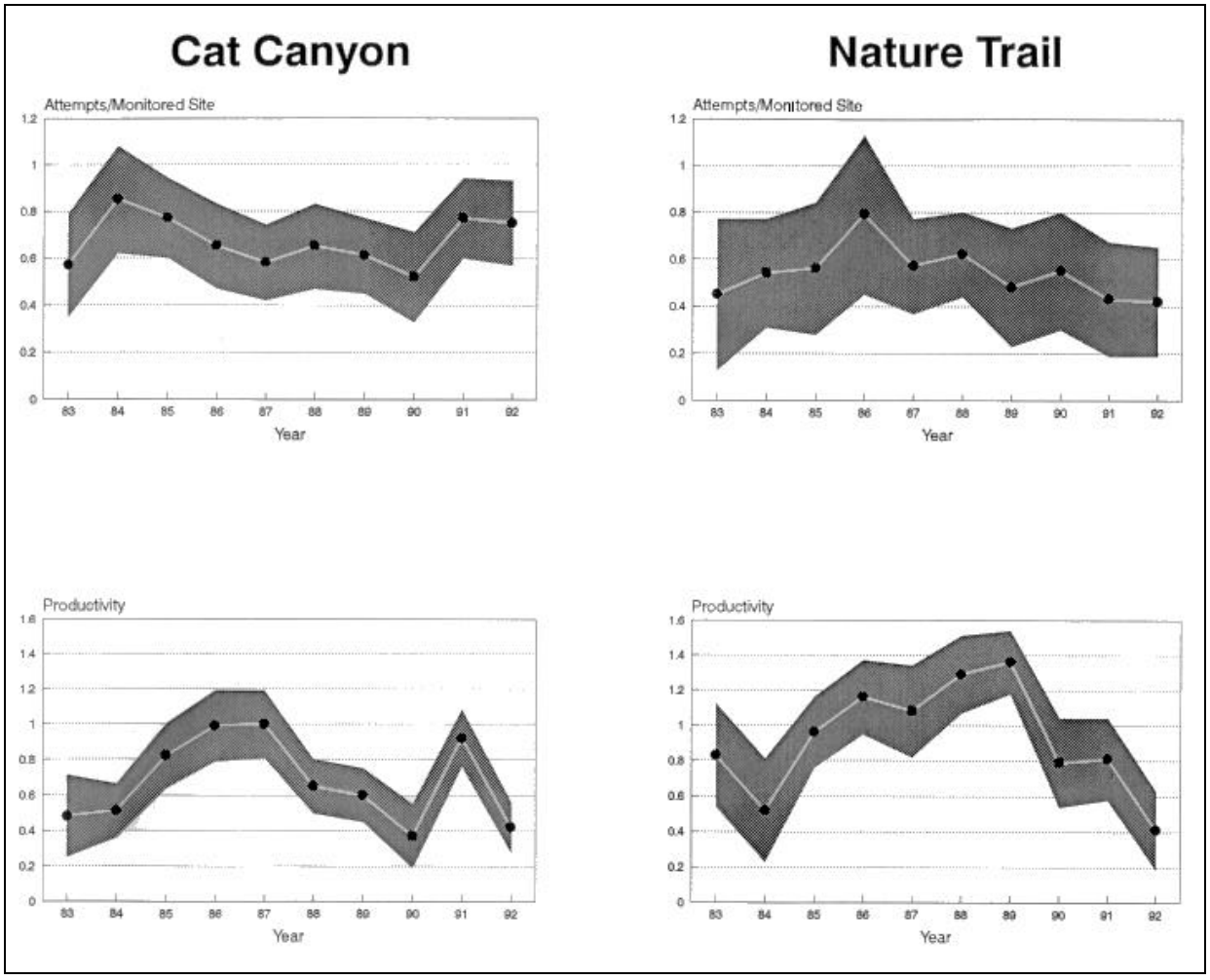
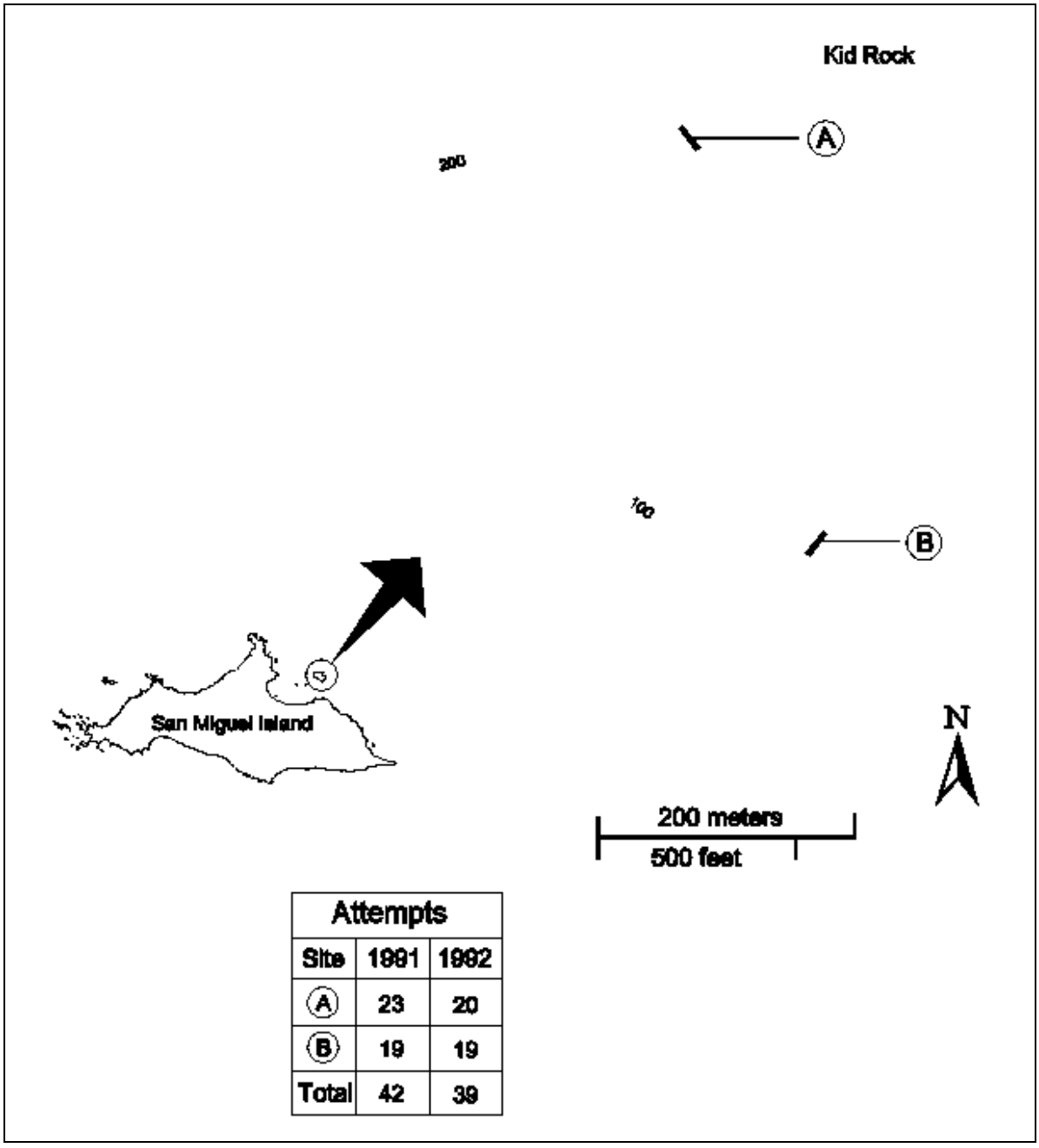


Figure 26. Nest attempts and productivity in Xantus' Murrelets at monitored sites on Santa Barbara Island, 1983–1992 (Mean and 95% confidence interval; CHIS Seabird Monitoring Program). Data for 1983–1984 (G. L. Hunt, Jr., unpubl.); 1985 (Lewis and Gress, unpubl. ms); 1986 (Lewis and Gress 1988); 1987–1989 (NPS, unpubl.); 1990 (Ingram 1992); 1991–1992 (this report).



Attempts		
Site	1991	1992
A	23	20
B	19	19
Total	42	39

Figure 27. Locations of nest boxes and nest attempts in Cassin's Auklets on Prince Island, 1991–1992 (CHIS Seabird Monitoring Program).

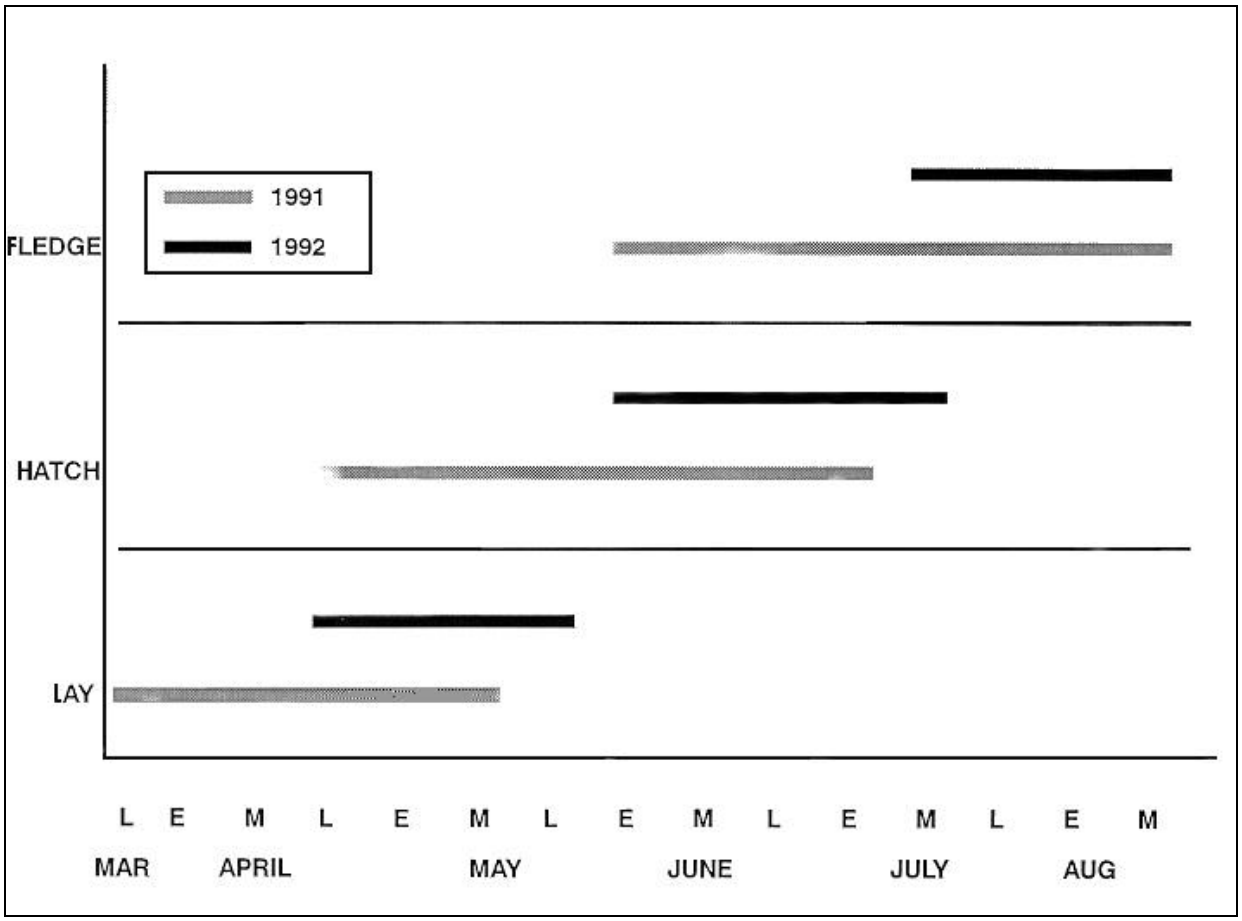


Figure 28. Breeding phenology in Cassin's Auklets in nest boxes on Prince Island, 1991–1992 (CHIS Seabird Monitoring Program).

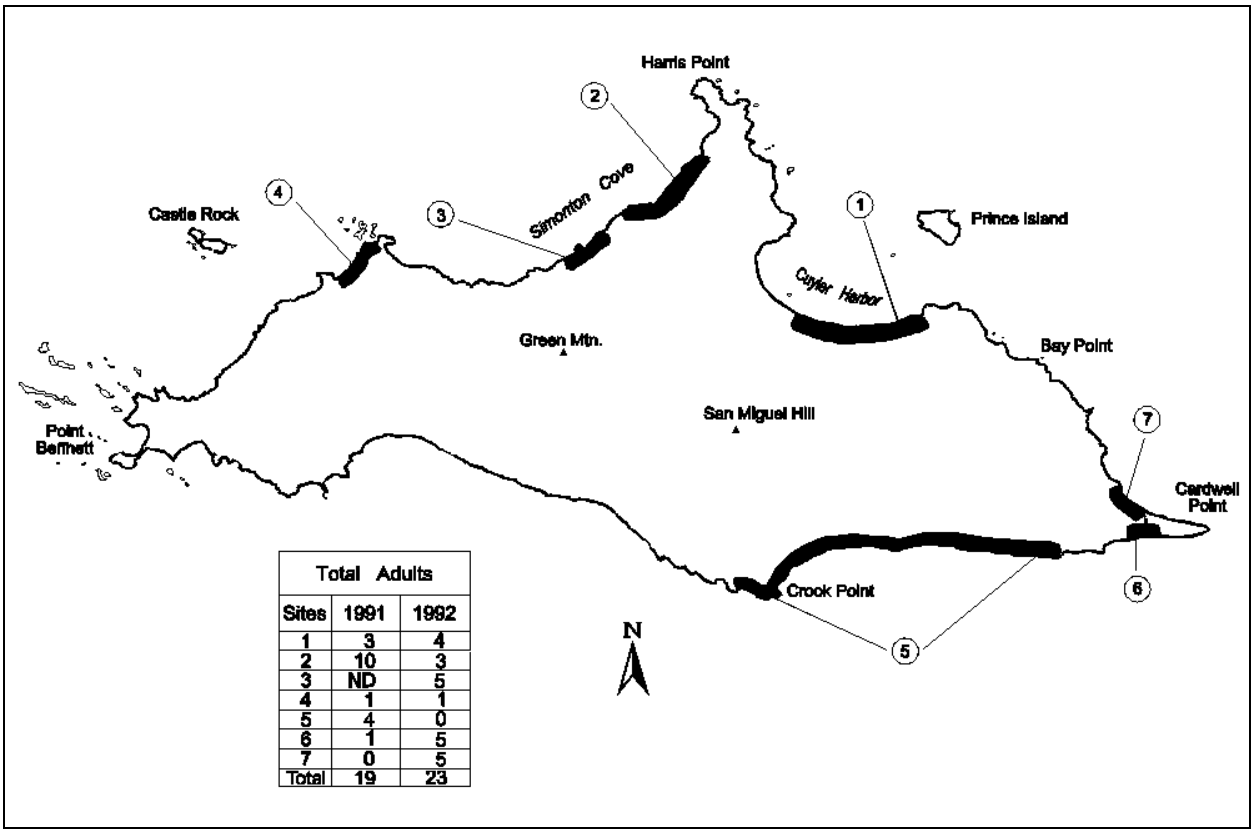


Figure 29. Distribution and number of breeding Snowy Plovers on San Miguel Island, 1991–1992 (PRBO, unpubl. data).

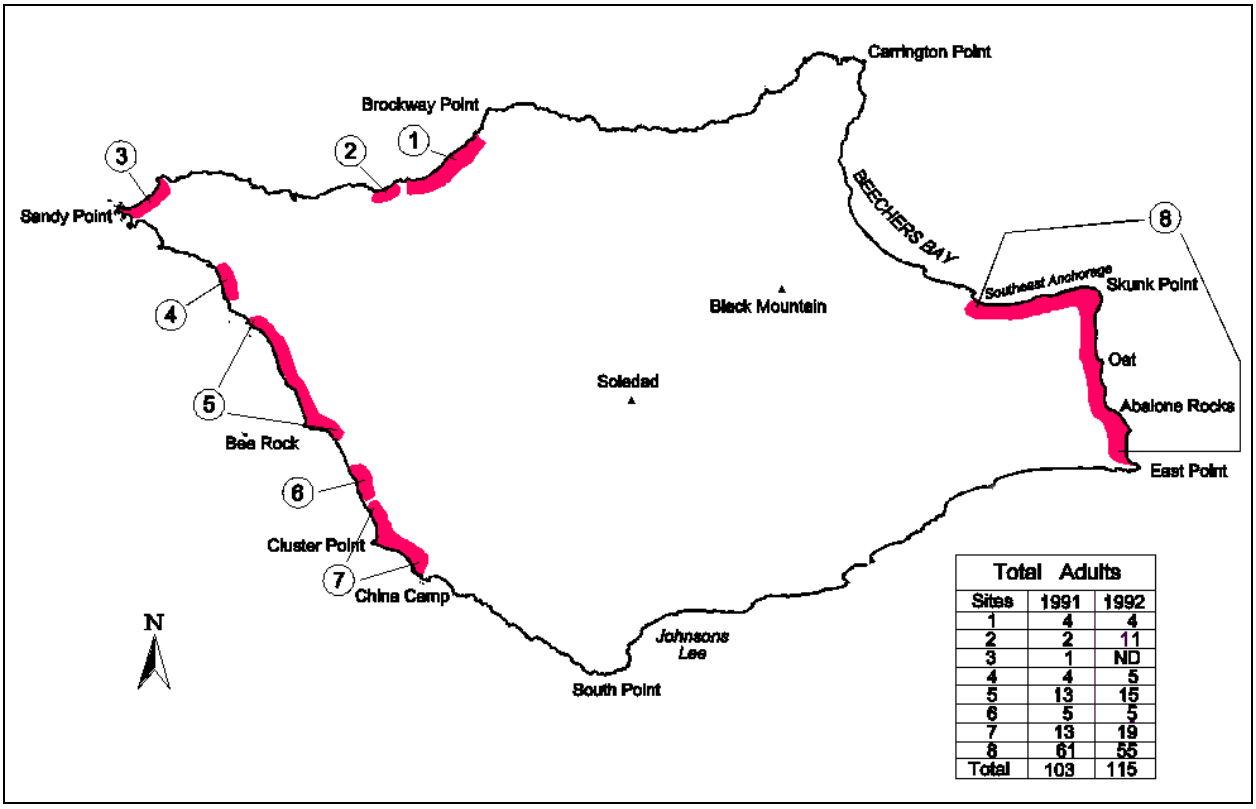


Figure 30. Distribution and number of breeding Snowy Plovers on Santa Rosa Island, 1991–1992 (PRBO, unpubl. data).

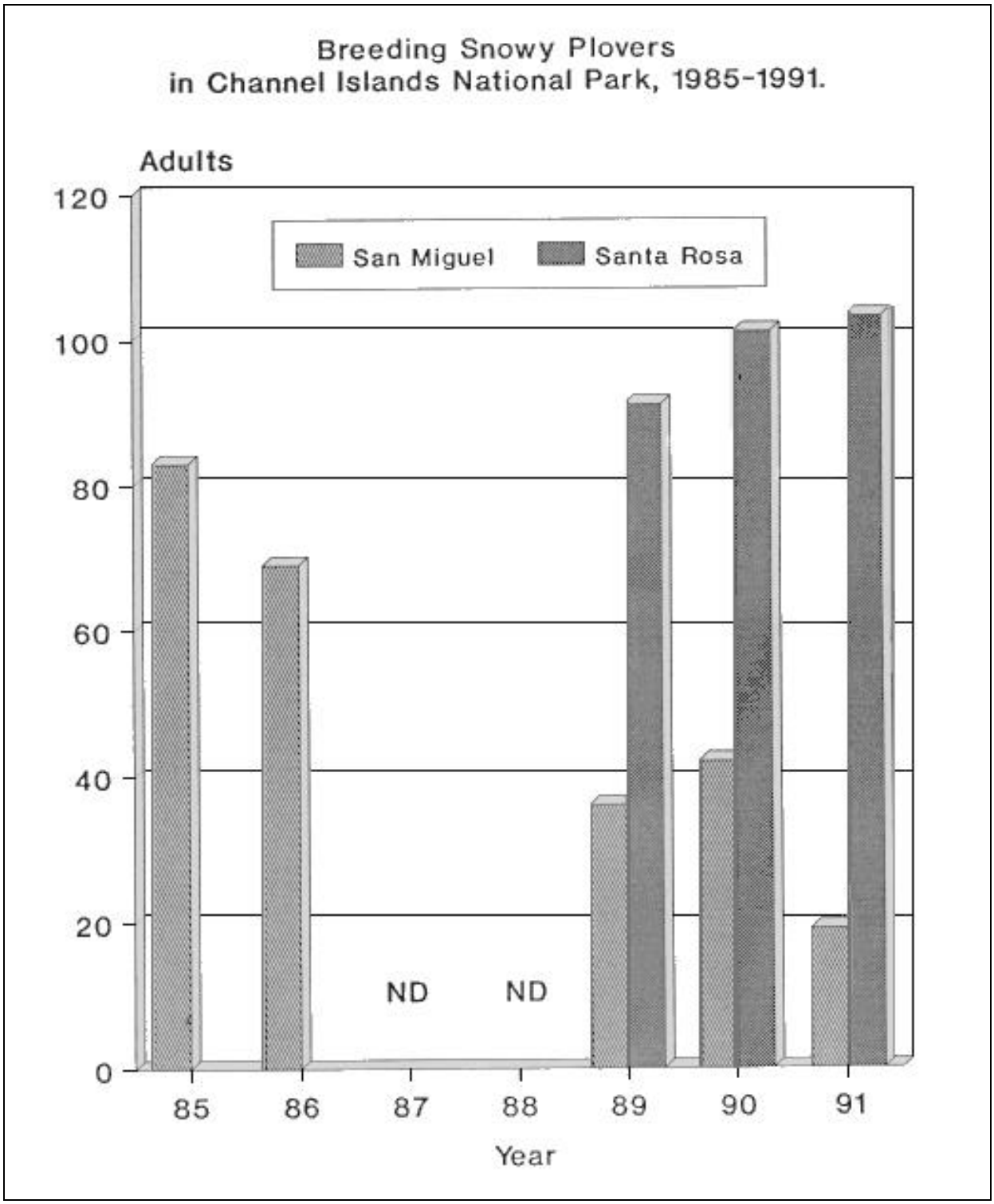


Figure 31. Breeding Snowy Plovers on San Miguel Island and Santa Rosa Island, 1985–1992 (PRBO, unpubl. data).

APPENDIX A

Breeding success of California Brown Pelicans in Channel Island National Park, 1969–1992.

ISLAND	YEAR	NESTS	FLEDGLINGS	PRODUCTIVITY
West Anacapa	1969	750	4	0.005
	1970	552	1	0.002
	1971	540	7	0.013
	1972	261	57	0.22
	1973	247	34	0.14
	1974	416	305	0.73
	1975	292	256	0.88
	1976	417	279	0.67
	1977	76	39	0.51
	1978	210	37	0.18
	1979	1258	980	0.78
	1980	2147	1438	0.67
	1981	2946	1805	0.61
	1982	1862	1175	0.63
	1983	1856	1149	0.62
	1984	628	530	0.84
	1985	5148	6387	1.24
	1986	5958	3986	0.67
	1987	6326	4057	0.64
	1988	2721	2465	0.91
	1989	4986	2877	0.58
	1990	2175	650	0.30
	1991	5765	1602	0.28
	1992	1486	372	0.25
Santa Barbara	1980	97	77	0.79
	1981	0	0	0.00
	1982	0	0	0.00
	1983	21	10	0.48
	1984	0	0	0.00
	1985	1046	1515	1.45
	1986	1441	615	0.43
	1987	841	641	0.76
	1988	157	35	0.22
	1989	973	623	0.64
	1990	225	4	0.02
	1991	618	187	0.30
	1992	266	22	0.08

Appendix A Legend

WEST ANACAPA ISLAND

- For census methods see Gress (1992).
- Data includes breeding effort on Scorpion Rock (approximately six nautical miles west of West Anacapa Island) in 1972 (112 nests, 31 fledglings), 1974 (105 nests, 75 fledglings), and 1975 (80 nests,74 fledglings).
- Re-nesting probably occurred in 1978 (210 pairs built 340nests).

- Data Sources:
  - 1969–1974: Anderson et al. (1975)
  - 1975–1980: Anderson and Gress (1983)
  - 1981: Gress (1982)
  - 1982: Gress et al. (1983)
  - 1983: Gress and Anderson (1984)
  - 1984: Gress and Anderson (1985)
  - 1985–1986: Lewis and Gress (1988)
  - 1987: Gress and Lewis (1988)
  - 1988–1989: Gress et al. (1990)
  - 1990–1992: Gress (unpubl. data)

SANTA BARBARA ISLAND

- For census methods see Gress (1992).
- No nesting occurred 1969–1979, 1981–1982, and 1984.
- Data Sources:
  - 1980: Gress (1981); Gress and Anderson (1983)
  - 1983: Gress and Anderson (1984)
  - 1985–1986: Lewis and Gress (1988)
  - 1987: Gress and Lewis (1988)
  - 1988–1989: Gress et al. (1990)
  - 1990: Ingram (1992)
  - 1991–1992: This report

APPENDIX B

Breeding Success of Double-Crested Cormorants in Channel Island National Park, 1969–1992.

ISLAND	YEAR	NESTS	FLEDGLINGS	PRODUCTIVITY
West Anacapa	1969	76	0	0.0
	1970	50	3	0.06
	1971	48	0	0.0
	1972	26	9	0.35
	1973	16	3	0.19
	1974	29	1	0.04
	1975	3	3	1.00
	1976	7	2	0.29
	1977	15	18	1.20
	1978	34	49	1.44
	1979	66	38	0.58
	1980	84	40	0.48
	1981	79	77	0.97
	1982	118	145	1.23
	1983	102	81	0.79
	1984	83	162	1.95
	1985	102	250	2.45
	1986	86	143	1.66
	1987	183	297	1.62
	1988	148	327	2.21
	1989	203	262	1.29
	1990	340	527	1.55
	1991	360	587	1.63
	1992	263	300	1.14
Santa Barbara	1972	66	ND	ND
	1976	42	96	2.29
	1977	67	63	0.94
	1982	68	ND	ND
	1985	60	120	2.00
	1986	64	107	1.67
	1987	171	271	1.58
	1988	162	297	1.83
	1989	212	310	1.46
	1990[1]	267	301	1.13
	1991[1]	509	875	1.72
	1992[1]	325	338	1.04

[1] These years include both land-based and aerial survey data which increases the amount of survey coverage of the colony.

Appendix B Legend

WEST ANACAPA ISLAND

- Data Sources
  - 1969–1972: Gress et al. (1973)
  - 1973–1980: Anderson and Gress (1983)
  - 1981, 1983–1985, 1987–1988, 1990–1992: F. Gress (unpubl. data)
  - 1982: Gress and Anderson (1983)
  - 1986: Lewis and Gress (1988)
  - 1989: CHIS (unpubl. data)

SANTA BARBARA ISLAND

- Data Sources:
  - 1972: Hunt and Hunt (1974)
  - 1976–1977: Hunt et al. (1979)
  - 1982: Ingram and Hunt (1982)
  - 1985–1986: Lewis and Gress (1988)
  - 1987–1989: CHIS (unpubl. data)
  - 1990: Ingram (1992)
  - 1991–1992: Carter et al. (1992), this report.